A

COURSE

OF

ELEMENTARY READING

IN

SCIENCE AND LITERATURE,

COMPILED FROM

POPULAR WRITERS;

TO WHICH IS ADDED,

A Copious List of the Latin and Greek Primitives

WHICH ENTER INTO THE COMPOSITION OF
THE ENGLISH LANGUAGE.

BY J. M. M'CULLOCH, D.D.,
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"A Series o. Lessons in Prose and Verse, progressively arranged," &c.

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PREFACE

TO THE SEVENTH EDITION.

In submitting to the public a Seventh Edition of his "Course of Reading," the Author is happy to think, that it is no longer necessary to preface it with any formal apology for the peculiar and somewhat novel character of its contents. The sale of six large impressions in a few years affords a pleasing evidence that he was not mistaken in supposing that a series of progressive lessons in useful knowledge would, in an inquiring age like the present, be deemed a more valuable contribution to Education than any mere selection, however excellent, of elegant and rhetorical readings. Nor has he less reason to be gratified with the favour awarded to the chief novelty of the work, the attempt to supply a List of the Principal Latin and Greek Roots which enter into the composition of the English language. The numerous imitations of this List which have subsequently appeared in the shape of Helps to English Etymology, &c., are so many proofs, that the plan of assisting the young Scholar to a knowledge of his mother tongue, by giving him some previous acquaintance with its leading Roots, only

required to be suggested in order to command general approbation. And the only subject of surprise is, that a plan of instruction should have been so long overlooked, which promises more effectually than any other to ensure to *all* pupils those facilities for acquiring a thorough acquaintance with the force and meaning of their native language, which used to be the exclusive possession of the Students of classical learning.

The present will be found in all respects more available to the purposes of tuition than any former Edition. Not only has the Work throughout,—including the List of Prefixes, Affixes, and Roots, in the Appendix,—been carefully revised; but, to ensure the greatest possible correctness, the whole of the scientific Lessons have been submitted to the revision of gentlemen eminent for their attainments in science: And it will probably be considered a sufficient presumption of philosophical accuracy, that they have received the corrections of Dr Greville, in the Botanical part; of Mr James Wilson, in the Zoological part; and of Dr Fyfe, Mr Trotter, and Mr Lees, in the Chemical, Geographical, and Physical departments respectively. An additional improvement,—introduced for the first time in the present impression, and fitted, it is hoped, to render the whole at once more useful and more attractive,—is a Series of Diagrams and other Pictorial Embellishments, illustrative of such parts of the text as may not be adequately understood without the help of delineations addressed to the eye.

To the Writers whose names are appended to the various Lessons, some apology is perhaps due for the liberties which have been occasionally taken in abridging, simplifying, and otherwise altering their productions;

yet, as the changes in question have been made solely for the purpose either of adapting the selections to the practical business of education, or of bringing their statements into more strict accordance with recent discoveries of science, it is hoped that they are only such as the Authors themselves would have introduced had their design been to supply a Manual of Elementary Reading.

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ON THE

INFLECTIONS OF THE VOICE.

The voice, in reading, has two essential turns or inflections, the *rising* and the *falling*. The *rising* inflection is that upward turn of the voice which we generally use in asking a question beginning with a verb, and is marked with the acute accent (´). The *falling* inflection is that downward sliding of the voice which is commonly used at the end of a sentence, and is designated by the grave accent (`). These two inflections have been justly described as the axis on which the force, variety, and harmony of speaking turn, and they therefore cannot be too fully exemplified to the pupil.

EXAMPLES.

The Rising followed by the Falling.

Does he talk rationally´, or irrationally`?
Does he pronounce correctly´, or incorrectly`?
Does he mean honestly´, or dishonestly`?
Does she dance gracefully´, or ungracefully`?
Do they act cautiously´, or incautiously`?
Should we say humour´, or humour`?
Should we say altar´, or altar`?
Should we say amber´, or amber`?
Should we say airy´, or airy`?
Should we say eager´, or eager`?
Should we say ocean´, or ocean`?
Should we say oozy´, or oozy`?
Should we say empty´, or empty`?

The Falling followed by the Rising.

He talks rationally`, not irrationally´.
He pronounces correctly`, not incorrectly´.
He means honestly`, not dishonestly´.
She dances gracefully`, not ungracefully´.
They acted cautiously`, not incautiously´.
We should say humour`, not humour´.
We should say altar`, not altar´.
We should say amber`, not amber´.

We should say airy\`, not airy′.
We should say eager\`, not eager′.
We should say ocean\`, not ocean′.
We should say oozy\`, not oozy′.
We should say empty\`, not empty′.

A great number of rules are given by Mr Walker and his followers for the inflecting of sentences or parts of sentences; but the following comprise all that are essential:—

I. AFFIRMATIVE SENTENCES.

1. Where the sense is complete, whether it be at the termination of a sentence or of a clause of a sentence, use the falling inflection.
2. In negative sentences, on the contrary, or negative members of sentences, use the rising inflection.
3. When sentences are divisible into two parts, the commencing part is distinguished by the rising inflection.

EXAMPLES.

1. It is to the unaccountable oblivion of our mortality, that the world owes all its fascination\`.

Age, in a virtuous person, carries with it an authority, which makes it preferable to all the pleasures of youth\`.

Every desire, however innocent or natural, grows dangerous, as, by long indulgence, it becomes ascendant\` in the mind.

You may lay it down as a maxim, confirmed by universal experience, that every man dies as he lives\`; and it is by the general tenor of the life, not a particular frame of mind at the hour of death, that we are to be judged at the tribunal of God.

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2. The religion of the gospel is not a gloom′y religion.

I cannot, I will not join in congratulation on misfortune and disgrace′.

Greatness confers no exemption from the cares and sorrows of huma′nity.

It is not enough that you continue steadfast and immovable′—you must also abound in the work of the Lord, if you expect your labours to be crowned with success.

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3. *If to do were as easy as to know what were good′ to do*—chapels had been churches, and poor men's cottages princes' palaces.

While dangers are at a distance, and do not immediately′ approach us—let us not conclude that we are secure, unless we use the necessary precautions against them.

As the beauty of the body always accompanies the health′ of it—so is decency of behaviour a concomitant to virtue.

No man can rise above the infirmities of nature′, unless assisted by God.

Your enemies may be formidable by their numbers, and by their power′, but He who is with you is mightier than they.

Virtue were a kind of misery′—if fame were all the garland that crowned her.

To all the charms of beauty, and the utmost elegance of external form′, Mary added those accomplishments which render their impression irresistible.

The only exception to these rules worthy of notice occurs in the case of antithetical sentences. When the commencing member of an antithesis requires the relative emphasis, or is opposed in the concluding member by a negation, the latter has the rising, and the former the falling inflection—as in the following examples:—

We have taken up arms to defend\` our country, not to betray it′.
The duty of a soldier is to obey\`, not to direct his general′.

II. INTERROGATIVE SENTENCES.

1. Questions asked by pronouns generally end with the falling inflection.

2. Questions asked by verbs generally require the rising inflection.

3. When the question affects two objects, taken *disjunctively*, the former has the rising, and the latter the falling inflection.

EXAMPLES.

1. What evil can come nigh to him for whom Jesus\` died?

2. Shall dust and ashes stand in the presence of that uncreated glory, before which principalities and powers bow down, tremble, and adore′? Shall guilty and condemned creatures appear in the presence of Him, in whose sight the heavens are not clean, and who chargeth his angels with folly′?

3. Are you toiling for fame′, or for fortune\`?

(1.) Who are the persons that are most apt to fall into peevishness and dejection\`? that are continually complaining of the world, and see nothing but wretchedness\` around them? (3.) Are they the affluent′ or the indigent\`? (2.) Are they those whose wants are administered to by a hundred hands besides their own′? who have only to wish and to have′?—Let the minion of fortune answer you. (2.) Are they those whom want compels to toil for their daily meal and nightly pillow′—who have no treasure, but the sweat of their brows′—who rise with the rising sun, to expose themselves to all the rigours of the seasons, unsheltered from the winter's cold, and unshaded from the summer's heat′? No! the labours of such are the very blessings of their condition.

III. PARENTHESIS.

The general rule for the parenthesis is, that it must be pronounced in a lower tone and more rapidly than the rest of the sentence, and conclude with the inflection that immediately precedes it. A simile, being a species of parenthesis, follows the same rule.

EXAMPLES.

Notwithstanding all this care of Cicero, history informs us that Marcus proved a mere blockhead; and that na′ture (who, it seems, was even with the son for her prodigality to the fa′ther) rendered him incapable of improving, by all the rules of el‵oquence, the precepts of philos‵ophy, his own endeav‵ours, and the most refined conversation in Ath‵ens.

Then went the captain with the officers, and brought them without vi‵olence (for they feared the people, lest they should have been stoned‵); and when they had brought them, they set them before the council.

IV. ECHO.

The title Echo, Mr Walker has adopted to express a repetition of a word or phrase. The echoing word is pronounced with the rising inflection, and a considerable pause after it.

EXAMPLE.

Newton was a Christian! *New′ton!* whose mind burst forth from the fetters cast by nature on our finite conceptions—*New′ton!* whose science was truth, and the foundation of whose knowledge of it was philosophy; not those visionary and arrogant presumptions which too often usurp its name, but philosophy resting on the basis of mathematics, which, like figures, cannot lie—*New′ton!* who carried the line and rule to the utmost barriers of creation, and explored the principles by which, no doubt, all created matter is held together and exists.

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SECTION I.

ON THE PLEASURES OF SCIENCE.

To pass our time in the study of the sciences has, in all ages, been reckoned one of the most dignified and happy of human occupations, and the name of Philosopher, or Lover of Wisdom, is given to those who lead such a life. But it is by no means necessary that a man should do nothing else than study known truths, and explore new, in order to earn this high title. Some of the greatest philosophers, in all ages, have been engaged in the pursuits of active life; and he who, in whatever station his lot may be cast, prefers the refined and elevating pleasures of knowledge to the low gratification of the senses, richly deserves the name of a Philosopher.

It is easy to show, that there is a positive gratification resulting from the study of the sciences. If it be a pleasure to gratify curiosity—to know what we were ignorant of—to have our feelings of wonder called forth, how pure a delight of this very kind does natural science hold out to its students! Recollect some of the extraordinary dis-

coveries of mechanical philosophy. Is there anything in all the idle books of tales and horrors, with which youthful readers are so much delighted, more truly astonishing, than the fact, that a few pounds of water may, without any machinery, by merely being placed in a particular way, produce an irresistible force? What can be more strange, than that an ounce weight should balance hundreds of pounds, by the intervention of a few bars of thin iron?—Observe the extraordinary truths which optical science discloses! Can anything surprise us more, than to find that the colour of white is a mixture of all others; that red, and blue, and green, and all the rest, merely by being blended in certain proportions, form what we had fancied rather to be no colour at all than all colours together?—Chemistry is not behind in its wonders. That the diamond should be made of the same material with coal; that water should be chiefly composed of an inflammable substance; that acids should be almost all formed of different kinds of air; and that one of those acids whose strength can dissolve almost any of the metals, should be made of the self-same ingredients with the common air we breathe; these surely, are things to excite the wonder of any reflecting mind—nay, of any one but little accustomed to reflect.—And yet these are trifling when compared to the prodigies which astronomy opens to our view: the enormous masses of the heavenly bodies; their immense distances; their countless numbers, and their motions, whose swiftness mocks the uttermost efforts of the imagination.

Akin to this pleasure of contemplating new and extraordinary truths, is the gratification of a more learned curiosity, by tracing resemblances and relations between things which, to common apprehension, seem widely different. It is surely a satisfaction, for instance, to know that the same thing which causes the sensation of heat causes also fluidity; that electricity, the light which is seen on the back of a cat when slightly rubbed on a frosty evening, is the very same matter with the lightning of the clouds: that plants breathe like ourselves, but differ-

ently, by day and by night; that the air which burns in our lamps enables a balloon to mount. Nothing can at first sight appear less like, or less likely to be caused by the same thing, than the processes of burning and of breathing,—the rust of metals and burning,—the influence of a plant on the air it grows in by night, and of an animal on the same air at any time, nay, and of a body burning in that air; and yet all these operations, so unlike to common eyes, when examined by the light of science, are the same. Nothing can be less like than the working of a vast steam-engine and the crawling of a fly upon the window; yet we find that these two operations are performed by the same means—the weight of the atmosphere; and that a seahorse climbs the ice-hills by no other power. Can anything be more strange to contemplate? Is there, in all the fairy-tales that ever were fancied, anything more calculated to arrest the attention, and to occupy and to gratify the mind, than this most unexpected resemblance between things so unlike to the eyes of ordinary beholders? Then, if we raise our views to the structure of the heavens, we are again gratified with tracing accurate but most unexpected resemblances. Is it not in the highest degree interesting to find, that the power which keeps the earth in its shape and in its path, wheeling round the sun, extends over all the other worlds that compose the universe, and gives to each its proper place and motion; that the same power keeps the moon in her path round the earth; that the same power causes the tides upon our earth, and the peculiar form of the earth itself; and that, after all, it is the same power which makes a stone fall to the ground? To learn these things, and to reflect upon them, fills the mind, and produces certain as well as pure gratification.

The highest of all our gratifications in the study of science remains. We are raised by science to an understanding of the infinite wisdom and goodness which the Creator has displayed in all his works. Not a step can we take in any direction without perceiving the most extraordinary traces of design; and the skill everywhere

conspicuous is calculated in so vast a proportion of instances to promote the happiness of living creatures, and especially of ourselves, that we can feel no hesitation in concluding, that if we knew the whole scheme of Providence, every part would appear to be in harmony with a plan of absolute benevolence. Independently, however, of this most consoling inference, the delight is inexpressible of being able to follow, as it were, with our eyes, the marvellous works of the great Architect of Nature, and to trace the unbounded power and exquisite skill which are exhibited in the most minute as well as in the mightiest parts of his system. BROUGHAM.

THE THREE KINGDOMS OF NATURE.

NATURAL objects have been in general arranged, for the purpose of classification, under the three grand divisions of *minerals*, *vegetables*, and *animals*. *Minerals* are natural bodies destitute of organization and life; *vegetables* or *plants* are natural bodies endowed with organization and life, but destitute of voluntary motion and sensation; and *animals* are natural bodies which possess organization, life, sensation, and voluntary motion.

1. *Minerals.*—If we penetrate beneath the surface of the earth, we discover there a remarkable arrangement. Instead of a generally uniform appearance, as we see on the surface, we pass through divers substances, as clay, gravel, sand, &c., deposited in *beds* or *strata* of various thickness, from a few inches to a great many feet. These lie, for the most part, nearly horizontal; but in some instances, particularly in mountainous countries, they take different degrees of inclination; and in places where the country consists of gently sloping hills and vales, the beds have a waving or bending form.—(*See Illustrations, Fig.* 1.)

These strata, as deep as the curiosity or the necessities of mankind have induced them to explore, satisfactorily demonstrate the wisdom which has been displayed in the arrangement of materials requisite for the use of men and animals. The first layer is frequently a rich black mould,

formed almost wholly of decomposed animal and vegetable remains: this yields sustenance to the vegetable productions, and thereby becomes the actual, though not the immediate, support of the whole animal creation. Beneath this is often found a thick bed of clay, that furnishes to man a substance of which to make bricks, tiles, various kinds of pottery, and innumerable other articles for the comfort of social life. Next are deposited vast beds of gravel, that are of use in numerous points of view. Underneath this are the infinitely varying strata of sandstone, limestone, &c., which not only serve for the construction of buildings, and for other important purposes, but also frequently surround mines, which contain the valuable metals. Beneath a slaty stratum are usually discovered those immense beds of coal so requisite for the comfort, and, in some situations, even for the existence of man. These strata, it is true, are not always found together, nor are they always discovered in the same order; but the statement will suffice to show the general nature of their arrangement.

The most simple and natural division of minerals is into four classes,—*stones*, *salts*, *combustibles*, and *metals*. Stones are subdivided into *earthy* and *saline;* and metals into *malleable* and *brittle.*

2. *Vegetables.*—The principal parts of plants are the *root;* the *herb*, *tree*, or *plant* itself; and the *fructification*, or flower and fruit.

The *roots* of plants and trees, having nothing pleasing to the eye, are, for the most part, hidden from the view; they are nevertheless of great importance in the vegetable economy; they are furnished with a set of vessels by means of which they draw moisture from the earth; and they fix the plant in the spot it is designed to occupy. They are of various kinds, and have different periods of duration; and they are frequently observed to compensate, in an extraordinary manner, for local inconveniences,—changing their direction, for instance, when they meet with a stone; turning aside from barren into fertile ground; and when stationed on the rocky edge of

a deep ditch, creeping down one side and ascending the other, so as to place themselves in richer soil.

The *plant* itself consists of cellular tissue and vessels curiously arranged, and adapted for performing all the functions of vegetable life. First of all is the *bark*, covered externally with the *cuticle*, which invests every part of a living plant, and varies in texture from the film which encloses the delicate petal of a flower, to the rough coating of a prickly aloe. The cuticle is furnished in many parts with pores, by which a communication is kept up between the internal structure and the atmosphere. To the cuticle succeeds the *cellular integument*, often of a green colour; and in the trunks of ordinary trees we next find the *cortical layers* and the *liber*, which forms the innermost boundary of the bark. Lastly, the wood is observed, which sometimes contains within it the pith, respecting the use of which philosophers are not agreed. The wood itself is divided into two parts,—the true wood and the *alburnum;* the latter is the new wood,—that which has been recently deposited, and is softer and of a paler colour. The annual depositions of woody matter produce the concentric circles, which not only contribute to the beauty of the woody surface, but furnish means by which the age of timber may be calculated. The *sap-vessels* ascend from the points of the roots, through the superficial alburnum, and enter the leaves in a circular arrangement round the pith. The fluid destined to nourish a plant, being absorbed in the root, becomes sap, and is carried up by these vessels into the leaves, where it undergoes a wonderful chemical change, and is brought back, through another set of vessels, down the leaf-stalks into the liber, where it is supposed to deposit the principal secretions of the tree. Thus, to the bark of the oak, a tanning principle is communicated;—to the Peruvian bark, what has been found so beneficial in fevers;—to the cinnamon, its grateful aromatic taste;—to the sandal-wood, its never-dying fragrance, so beautifully noticed in an Aga couplet, which pronounces the duty of a good man to consist, not only in pardoning, but

also in benefiting his enemies, as the sandal-tree, at the moment of its overthrow, sheds the sweetest perfume on the axe that fells it.

The parts of *fructification* are, the *calyx*, *corolla*, *stamens*, *pistils*, *seed-vessel*, *seeds*, and *receptacle*. The *calyx*, or flower-cup, is the green part which is situated immediately beneath the blossom; the *corolla*, or blossom, is that coloured part of the flower, on which its beauty principally depends, and the leaves that compose it are denominated *petals*. The *stamens* and *pistils* are in the centre of the flower, and are the organs on which the fructification and reproduction of the plant more particularly depend. The former surround the latter, and consist each of a *filament* or thread, and an *anther* or summit; which last, when ripe, contains a fine powder called *pollen*. At the foot of the pistil is situated the *germen;* this, when grown to maturity, has the name of *pericarp*, or seed-vessel, and is that part of the fructification which contains the seeds—whether it be a *capsule* as in the poppy, a *nut* as in the filbert, a *berry* as in the gooseberry, a *pod* as in the pea, or a *cone* as in the fir-tree. The *seed* is so well known as to require no description; and the *receptacle* is the base which connects all the parts of fructification together, and on which they are seated; as, for example, the eatable part of the artichoke.—(*See Illustrations*, *Fig*. 2.)

3. *Animals.*—The objects comprehended within the *animal* kingdom are divided into six classes,—*Mammalia*, or mammiferous animals; *Birds;* *Amphibia*, or amphibious animals, including all reptiles; *Fishes;* *Insects;* and *Worms*. The class *Mammalia* consists of such animals as produce *living* offspring, and nourish their young ones with milk supplied from their bodies; and it comprises quadrupeds, bats, seals, and whales. The class *Birds* comprises all such animals as have their bodies clad with feathers. Under the third class, or *Amphibia*, are arranged such animals as have a cold and generally naked body. They respire chiefly by lungs, but they have the power of suspending respiration for a long time; they are extremely tenacious of life, and can repair

certain parts of their bodies which have been lost; they are also able to endure hunger, sometimes even for months, without injury. *Fishes* constitute the fourth class of animals; they are all inhabitants of the water, in which they move by certain organs called *fins;* they breathe by *gills.* *Insects* are so denominated, from the apparent divisions of their bodies, as if they were intersected or cut into parts. They have *three* principal parts,—the *head*, the *thorax*, and the *abdomen.* They have in general *six* or more legs, besides wings, and *antennæ*, or instruments of touch; and they nearly all go through certain great *changes* at different periods of their existence. The sixth and last class of animals consists of *Worms* or *Vermes*, which are slow of motion, and have soft and fleshy bodies. These animals are principally distinguished from those of the other classes, by having *tentacula* or feelers.

Such are the three kingdoms of nature, and their principal divisions according to the system of Linnæus, a distinguished naturalist of Sweden, who flourished about the middle of the eighteenth century. These kingdoms, though distinct, are mutually connected; and it is not always easy to say of a natural object to which of them it belongs. The mineral kingdom indeed can never be confounded with the other two; for fossils are masses of mere dead unorganized matter, growing indeed by the addition of extraneous substances, but not fed by nourishment taken into an organized and living structure. Vegetables and animals, on the contrary, often resemble each other so closely as to render them scarcely distinguishable. If it be asked, what is the *vital* principle which belongs to the two last classes, and distinguishes them from the first, we must own our complete ignorance. We know it, as we know its Omnipotent Author, by its effects.

TO THE SUNDIAL.

My ear is pain'd, my heart is sick,
When all beside is silent round,

To hear the clock's unvaried click
  Repeat its melancholy sound.

'Tis irksome in the dead of night
  To have Time's progress thus made known,
And his irrevocable flight
  Proclaim'd in such a sullen tone.

To know that thus in darkness fly
  Boons far beyond the gift of kings;
That moments—hours—are gliding by,
  Which bear no record on their wings.—

Nothing to show their lapse redeem'd
  From dull Oblivion's barren void;
But idle, useless, unesteem'd,
  Have found and left us unemployed.

Better I love—since time must pass—
  To witness in the light of day
The noiseless sand-grains in the glass
  By slow succession drop away.

With still more joy to thee I turn,
  Meet horologe for Bard to love,
Time's sweetest flight from thee I learn,
  Whose lore is borrow'd from above.

The worldly use of time may need
  Less cumbrous things its course to tell,—
I love thy massive tome to read,
  To read—and—feel its voiceless spell.

I love in some sequester'd nook
  Of antique garden to behold
The page of thy sun-lighted book
  Its touching homily unfold.

On some old terrace-walk to greet
  Thy form, a sight which never cloys,
Is more to thought than drink and meat—
  To feeling than Art's costliest toys.

These seem to track the path of time
  By vulgar means which man has given;
Thou, simple, silent, and sublime,
  But showst thy shadowy sign from Heaven.

BARTON.

PROOFS OF THE ROTUNDITY OF THE EARTH.

The spherical form of the earth is the fundamental principle of geography. The proofs of this truth present themselves to the senses, and they consist in certain remarkable appearances, either of objects upon the surface of the earth, or of the heavenly bodies.

Why do towers, vessels, and mountains, when we recede from them, appear to sink below the horizon, commencing with the base; and why, on the contrary, when we approach them, do these objects show first their summits, then their middle, and last of all their bases? These phenomena prove evidently that an apparent plane upon the earth is a curve surface, and that it is the convexity of this surface which conceals from the eye of the spectator upon the beach the hull of the vessel of which he sees the masts and sails. These things, too, happen uniformly towards whatever part of the earth we travel, whether towards the east or towards the west, towards the north or towards the south; it is impossible, therefore, to avoid drawing the conclusion, that the whole surface of the earth is, on all sides, nearly regularly curved; or, in other words, that the earth is a body approaching in figure more or less to a sphere.—(*See Illustrations*, *Fig.* 3.)

The same inference is deducible from an observation of the heavens. The *polestar* is that point in the heavens, which, itself alone immovable, appears to serve as a pivot to the apparent motions of the heavenly bodies. Now, if we proceed towards the north, we see the polestar take a position more elevated in the heavens, with regard to the horizon. If we go towards the south, this same star appears to sink, and others, before invisible, appear successively to rise. It is therefore impossible that the line whose direction we follow can be a straight line traced upon a horizontal plane; it can only be a curve; and as the same change everywhere takes place, it is natural to conclude that the earth has at least a circular form from north to south. The fact that the sun rises sooner to those who dwell more towards the east,

and gradually later to others in proportion as they are removed to the west, proves that it is equally circular from east to west; for were it flat, the sun would begin to illuminate all parts of its surface at the same instant.

Another most convincing proof is furnished by the eclipses of the moon. These eclipses are known to be caused by the earth coming between the sun and moon, and intercepting or cutting off the supply of light from the sun which illuminates the moon's surface or disk; the dark part of the moon's disk is, therefore, nothing more than a representation of the earth's shadow at the distance of the moon. In whatever position the earth happens to be at the time of an eclipse, its shadow upon the moon's disk is always in the form of a circle or of part of a circle; the earth must therefore be a sphere, since no other than a spherical body, in every position in which it can be placed with respect to another body giving light, can cast a circular shadow upon a third body.

The numerous voyages which have been made round the world have finally shut the mouths of all those who persisted in regarding the earth as a round plane, or a hemispherical disk. Navigators, such as Magellan and Drake, sailing from Europe, have pursued a course always towards the west (making only some deviations, in order to double the lands which stretch towards the south), and, without quitting this general direction, have returned to the same place whence they set out. Heemskerk, when he wintered at Nova Zembla, confirmed what astronomers had concluded from the spherical figure of the earth; namely, that the days and nights near the poles extend to several months. Finally, Cook, in approaching as near as possible to the southern polar circle, found that the voyage round was always diminished proportionably to the diminution of his distance from the pole; so that we have thus obtained an ocular proof of the rotundity of the earth towards the south pole as well as towards the north.

So many united proofs, as well as the accuracy of so many astronomical observations, all of which have been

made and calculated upon the supposition of the sphericity of our earth, leave no room for reasonable doubts upon the subject. In vain does ignorance demand of us how the earth can remain suspended in the air without any support. Let us look upon the heavens, and observe how many other globes roll in space. Let us then lay aside all uneasiness concerning the *antipodes*, that is, the people of the earth whose feet are turned towards ours: there is upon the globe neither high nor low; the antipodes see, in like manner as we do, the earth under their feet, and the sky over their heads. MALTE-BRUN.

THE MINISTRY OF ANGELS.

AND is there care in heaven, and is there love
In heavenly spirits to these creatures base,
That may compassion of their evils move?
There is, or else more wretched were the case
Of men than beasts. But oh! the exceeding grace
Of highest God! that loves his creatures so,
And all his works with mercy doth embrace,
That blessed angels he sends to and fro,
To serve to wicked men,—to serve his wicked foe.

How oft do they their silver bowers leave,
To come to succour us that succour want!
How oft do they with golden pinions cleave
The flitting skies, like flying pursuivant,
Against foul fiends to aid us militant!
They for us fight, they watch and duly ward,
And their bright squadrons round about us plant;
And all for love, and nothing for reward:
Oh; why should heavenly God to man have such regard!

SPENSER.

THE INCARNATION.

FOR thou wast born of woman, thou didst come,
O Holiest! to this world of sin and gloom,
Not in thy dread omnipotent array;
And not by thunders strew'd
Was thy tempestuous road,
Nor indignation burnt before thee on thy way;

But thee, a soft and naked child,
Thy mother, undefiled,
In the rude manger laid to rest
From off her virgin breast.

The heavens were not commanded to prepare
A gorgeous canopy of golden air;
Nor stoop'd their lamps the enthroned fires on high;
    A single silent star
    Came wandering from afar,
Gliding uncheck'd and calm along the liquid sky;
The Eastern Sages leading on,
As at a kingly throne,
To lay their gold and odours sweet
Before thy infant feet.

The earth and ocean were not hush'd to hear
Bright harmony from every starry sphere;
Nor at thy presence brake the voice of song
    From all thy cherub choirs,
    And seraphs' burning lyres,
Pour'd through the host of heaven the charmed clouds along;
One angel troop the strain began,
Of all the race of man,
By simple shepherds heard alone,
That soft Hosanna's tone.

And when thou didst depart, no car of flame
To bear thee hence in lambent radiance came;
Nor visible angels mourn'd with drooping plumes;
    Nor didst thou mount on high
    From fatal Calvary
With all thine own redeem'd outbursting from their tombs;
For thou didst bear away from earth
But one of human birth,
The dying felon by thy side, to be
In Paradise with thee.

Nor o'er thy cross did clouds of vengeance break;
A little while the conscious earth did shake
At that foul deed by her fierce children done;
    A few dim hours of day
    The world in darkness lay,
Then bask'd in bright repose beneath the cloudless sun:

While thou didst sleep beneath the tomb,
Consenting to thy doom,
Ere yet the white-robed Angel shone
Upon the sealed stone.

And when thou didst arise, thou didst not stand
With devastation in thy red right hand,
Plaguing the guilty city's murtherous crew;
    But thou didst haste to meet
    Thy mother's coming feet,
And bear the words of peace unto the faithful few;
Then calmly, slowly didst thou rise
Into thy native skies,
Thy human form dissolved on high
Into its own radiancy.

MILMAN.

WHAT IS THE USE WE MAKE OF THE SCRIPTURES?

ALL our practical knowledge of God is comprised in the Bible. All that we can know of our Creator, of our relation to him, of his will, of his intentions concerning us, of our prospects after death,—all such knowledge we derive from this source. The Bible then ought to be to us that which the chart and the compass are to the mariner on a stormy ocean; we have absolutely no other guide, no other directory to our course. In what light then do we practically regard the Bible? Is it enough to possess the Scriptures, to have been instructed out of the Scriptures in infancy, to hear them read in public worship, to have a general approbation of their contents? Would it be satisfactory to the mariner merely to possess a compass on board his vessel; to have received information as to its use in infancy, to admire its utility, or to discourse sometimes publicly of its merits; meanwhile he is driving on, it may be, to rocks, to shores, to sands, or quite away from his course?

But how many an individual lives in this precise manner, as to his use of the Scriptures! Day passes after day, week after week, month after month, year after year, and God marks not his anxious eye pondering over

this chart of life. Politics, science, poetry, history, it may be lighter productions,—these can arrest his attention and interest his mind; but the Bible which notifies the way-marks to eternity,—this excites no interest. And yet such a person perhaps expects God's favour—expects to reach the harbour of endless peace, and never even dreams of the probability of intervening shipwreck! Mournful and inconsistent expectations! Is this to work out salvation "with fear and trembling;" is this to honour the statutes of the Sovereign of the universe; is this to value the counsels of a heavenly parent and benefactor; is this to betoken anxiety for the blessings of his great salvation?

Many, however, are to be found who are by no means chargeable with this entire neglect of the Scriptures. Some have, from infancy, acquired regular habits of reading the Bible, and peruse, as a daily or at least as a weekly task, their allotted chapters. But they do this oftentimes without anxiety, and without progress in religious knowledge. The *fact* of reading is to them more important than the *contents* which they read. They manifest no submission of the heart to God's teaching—no godly diligence to lay up in the soul his statutes and promises. Eternity fastens not upon their thoughts—the wonders of redeeming love attract not their affections. They read with coldness, and languor, and unconcern. There is no solicitude whether they understand, whether they feel, whether they remember, whether they obey—whether or not that mighty record of truth dispel falsehood, and tear away sin from their souls. There is no scrutiny as to the effect of their knowledge—as to the conformity of their views, and sentiments, and habits, with the decisions and intentions of God! The heart makes no progress in its voyage—it is no nearer to God—no nearer to the dispositions of Heaven than it was many years ago.

Think again of the mariner—his eye glances daily upon his compass—or once a-week he fixes his look upon the needle; but he uses not the helm—he brings not the

vessel into the prescribed course! As well then might the compass be cast into the depths of the sea! Now it is evident that this is not the use of the Scriptures which God demands—this is not to possess any anxiety as to the knowledge of God's will. Those who thus neglect, or thus imperfectly respect the Scriptures, are not among those who "work out their salvation with fear and trembling." NOEL.

THE POWER OF GOD.

THOU art, O God, the life and light
  Of all this wondrous world we see;
Its glow by day, its smile by night,
  Are but reflections caught from Thee!
Where'er we turn, thy glories shine,
And all things fair and bright are Thine.

When day with farewell beam delays
  Among the opening clouds of even,
And we can almost think we gaze
  Through golden vistas into heaven,
Those hues that mark the sun's decline,
So soft, so radiant, Lord, are Thine.

When night, with wings of stormy gloom,
  O'ershadows all the earth and skies,
Like some dark beauteous bird, whose plume
  Is sparkling with a thousand eyes,
That sacred gloom, those fires divine,
So grand, so countless, Lord, are Thine.

When youthful spring around us breathes,
  Thy spirit warms her fragrant sigh,
And every flower the summer wreaths
  Is born beneath that kindling eye:
Where'er we turn, thy glories shine,
And all things bright and fair are Thine. MOORE.

GENERAL PROPERTIES OF BODIES.

Mrs B. Emily.

Mrs B. WHEN I speak of *bodies*, I mean substances,

of whatever nature, whether solid, fluid, or aeriform; and *matter* is the general term used to denote the substance, whatever its nature be, of which the different bodies are composed. Thus, wood is the matter of which this table is made; water is the matter with which this glass is filled, &c.

E. I am very glad you have explained the meaning of the word matter, as it has corrected an erroneous conception I had formed of it; I thought that it was applicable to solid bodies only.

Mrs B. There are certain properties which appear to be common to all bodies, and are hence called the *general properties* of bodies; these are *impenetrability*, *extension*, *figure*, *divisibility*, and *inertia*.

By *impenetrability* is meant the property which bodies have of occupying a certain space, so that where one body is, another cannot be without displacing the former. Two bodies cannot exist in the same place at the same time. A liquid may be more easily removed than a solid body; yet it is not the less substantial, since it is as impossible for a liquid and a solid to occupy the same space at the same time, as for two solid bodies to do so. For instance, if you put a spoon into a glass full of water, the water will flow over to make room for the spoon.

E. I understand this perfectly. Liquids are in reality as substantial or as impenetrable as solid bodies; and they appear less so only because they are more easily displaced.

Mrs B. Air is a fluid differing in its nature from liquids, but no less impenetrable. If I reverse this goblet and plunge it perpendicularly into water, so that the air will not be able to escape, the water will no longer fill the goblet.

E. But it rises a considerable way into it.

Mrs B. Because the water compresses or squeezes the air into a small space in the upper part of the goblet; but, as long as it remains there, no other body can occupy the same place.

E. A difficulty has just occurred to me with regard to

the impenetrability of solid bodies; if a nail is driven into a piece of wood, it penetrates it, and both the wood and the nail occupy the same space that the wood alone did before.

Mrs B. The nail penetrates between the particles of the wood, by forcing them to make way for it; and if the wood is not increased in size by the addition of the nail, it is because wood is a porous substance like sponge, the particles of which may be compressed or squeezed closer together, and it is thus that they make way for the nail.

We may now proceed to the next general property of bodies, *extension.* A body which occupies a certain space must necessarily have extension; that is to say, *length*, *breadth*, and *depth:* these are called the dimensions of extension. Can you form an idea of any body without them?

E. No, certainly I cannot; though these dimensions must, of course, vary extremely in different bodies. The length, breadth, and depth of a box, or of a thimble, are very different from those of a walking-stick or of a hair. But is not height also a dimension of extension?

Mrs B. Height and depth are the same dimension, considered in different points of view. If you measure a body or a space from the top to the bottom, you call it depth; if from the bottom upwards, you call it height; thus the depth and height of a box are in fact the same thing.

E. Very true; a moment's consideration would have enabled me to discover that.

Mrs B. The limits of extension constitute *figure* or shape. You conceive that a body having length, breadth, and depth, cannot be without form, either symmetrical or irregular?

E. Undoubtedly; and this property admits of almost an infinite variety.

Mrs B. Nature has assigned regular forms to her productions in general. The natural form of mineral substances is that of crystals, of which there is a great variety. Many of them are very beautiful, and no less

remarkable by their transparency or colour, than by the perfect regularity of their forms, as may be seen in the various museums and collections of natural history. The vegetable and animal creations appear less symmetrical, but are still more diversified in figure than the mineral kingdom. Manufactured substances assume the various arbitrary forms which the art of man designs for them; and an infinite number of irregular forms are produced by fractures, and by the dismemberment of the parts of bodies.

E. Such as a piece of broken china or glass.

Mrs B. Or the fragments of mineral bodies which are broken in being dug out of the earth, or decayed by the effects of torrents and other causes. The picturesque effect of rock-scenery is, in a great measure, owing to accidental irregularities of this kind.

Divisibility is a susceptibility of being divided into an indefinite number of parts. Take any small quantity of matter,—a grain of sand for instance,—and cut it into two parts; these two parts might be again divided, had we instruments sufficiently fine for the purpose; and if by means of pounding, grinding, and other similar methods, we carry this division to the greatest possible extent, and reduce the body to its finest imaginable particles, yet not one of the particles will be destroyed, and the body will continue to exist, though in this altered state.

E. I have heard that a single pound of wool may be spun so fine as to extend to nearly 100 miles in length; this appears to me a very remarkable instance of the power of divisibility.

Mrs B. It is certainly. The melting of a solid body in a liquid also affords a very striking example of the extreme divisibility of matter. When you sweeten a cup of tea, for instance, with what minuteness the sugar must be divided to be diffused throughout the whole of the liquid!

E. And if you pour a few drops of red wine into a

glass of water, they immediately tinge the whole of the water, and must therefore be diffused throughout it.

Mrs B. Exactly so; and the perfume of this lavender-water will be almost as instantaneously diffused throughout the room, if I take out the stopper.

E. But in this case it is only the perfume of the lavender, and not the water itself, that is diffused in the room.

Mrs B. The odour or smell of a body is part of the body itself, and is produced by very minute particles or exhalations which escape from odoriferous bodies. It would be impossible that you should smell the lavender-water, if particles of it did not come in actual contact with your nose.

E. But when I smell a flower, I see no vapour rise from it, and yet I can smell it at a considerable distance.

Mrs B. You can, I assure you, no more smell a flower, the odoriferous particles of which do not touch your nose, than you can taste a fruit, the flavoured particles of which do not come in contact with your tongue.

E. That is wonderful indeed; the particles, then, which exhale from the flower, and from the lavender-water, are, I suppose, too small to be visible?

Mrs B. Certainly; you may form some idea of their extreme minuteness from the immense number which must have escaped in order to perfume the whole room; and yet there is no sensible diminution of the liquid in the phial.

E. But the quantity must really be diminished?

Mrs B. Undoubtedly; and were you to leave the bottle open a sufficient length of time, the whole of the liquid would evaporate and disappear. But though so minutely subdivided as to be imperceptible to any of our senses, each particle would continue to exist; for it is not within the power of man to destroy a single particle of matter; nor is there any reason to suppose that in nature an atom is ever annihilated.

E. Yet, when a body is burnt to ashes, part of it, at

least, appears to be effectually destroyed. Look how small is the residue of ashes beneath the grate from all the coals which have been consumed within it!

Mrs B. That part of the coals which you suppose to be destroyed evaporates in the form of smoke, whilst the remainder is reduced to ashes. A body, in burning, undergoes, no doubt, many remarkable changes;—it is generally subdivided;—its form and colour are altered;—its extension increased;—but the various parts, into which it has been separated by combustion, continue in existence, and retain all the essential properties of bodies. No particle of matter is ever destroyed: this is a principle you must constantly remember. Everything in nature decays and corrupts in the lapse of time. We die, and our bodies moulder to dust; but not a single atom of them is lost: they serve to nourish the earth, whence, while living, they draw their support.

The remaining essential property of matter is called *inertia;* this word expresses the resistance which inactive matter makes to a change of state. Bodies appear not only to be incapable of changing their actual state, whether it be of motion or of rest, but to be endowed with a *power of resisting* such a change. You know that it requires force to put a body, which is at rest, in motion; an exertion of strength is also requisite to stop a body which is already in motion. The resistance of the body to a change of state, in either case, is called *inertia.*

E. In playing at base-ball, I am obliged to use all my strength to give a rapid motion to the ball; and when I have to catch it, I am sure I feel the resistance it makes to being stopped; but if I did not catch it, it would soon fall to the ground and stop of itself.

Mrs B. Inert matter is as incapable of stopping of itself as it is of putting itself into motion. When the ball ceases to move, therefore, it must be stopped by some other cause or power; but as it is one with which you are yet unacquainted, we cannot at present investigate its effects.

MRS MARCET.

ON THE DOWNFAL OF POLAND.

OH! sacred Truth! thy triumph ceased a while,
And Hope, thy sister, ceased with thee to smile,
When leagued Oppression pour'd to Northern wars
Her whisker'd pandoors and her fierce hussars,
Waved her dread standard to the breeze of morn,
Peal'd her loud drum, and twang'd her trumpet-horn:
Tumultuous horror brooded o'er her van,
Presaging wrath to Poland—and to man!

Warsaw's last champion, from her height surveyed,
Wide o'er the fields, a waste of ruin laid,—
Oh! Heaven! he cried,—my bleeding country save!
Is there no hand on high to shield the brave?
Yet, though Destruction sweep those lovely plains,
Rise, fellow-men! our country yet remains!
By that dread name we wave the sword on high!
And swear for her to live!—with her to die!

He said, and on the rampart-heights arrayed
His trusty warriors, few, but undismayed;
Firm-paced and slow, a horrid front they form,
Still as the breeze, but dreadful as the storm;
Low murmuring sounds along their banners fly,
Revenge, or death,—the watchword and reply;
Then peal'd the notes omnipotent to charm,
And the loud tocsin toll'd their last alarm!—

In vain, alas! in vain, ye gallant few!
From rank to rank your volleyed thunder flew:—
Oh! bloodiest picture in the book of Time,
Sarmatia fell, unwept, without a crime;
Found not a generous friend, a pitying foe,
Strength in her arms, nor mercy in her woe!
Dropp'd from her nerveless grasp the shatter'd spear,
Closed her bright eye, and curb'd her high career;
Hope, for a season, bade the world farewell,
And Freedom shriek'd—as KOSCIUSKO fell!

The sun went down, nor ceased the carnage there,
Tumultuous murder shook the midnight air—
On Prague's proud arch the fires of Ruin glow,
His blood-dyed waters murmuring far below

The storm prevails, the rampart yields a way,
Bursts the wild cry of horror and dismay!
Hark! as the smouldering piles with thunder fall,
A thousand shrieks for hopeless mercy call!
Earth shook—red meteors flash'd along the sky,
And conscious nature shudder'd at the cry!

Departed spirits of the mighty dead!
Ye that at Marathon and Leuctra bled!
Friends of the world! restore your swords to man,
Fight in his sacred cause, and lead the van!
Yet for Sarmatia's tears of blood atone,
And make her arm puissant as your own!
Oh! once again to Freedom's cause return
The patriot TELL—the BRUCE of BANNOCKBURN.

CAMPBELL.

PULPIT ELOQUENCE.

Infidelity.—IT is amidst trials and sorrows that infidelity appears in its justest and most frightful aspect. When subjected to the multifarious ills which flesh is heir to, what is there to uphold our spirit but the discoveries and the prospects that are unfolded to us by revelation? What, for this purpose, can be compared with the belief that everything here below is under the management of infinite wisdom and goodness, and that there is an immortality of bliss awaiting us in another world? If this conviction be taken away, what is it that we can have recourse to, on which the mind may patiently and safely repose in the season of adversity? where is the balm which I may apply with effect to my wounded heart, after I have rejected the aid of the Almighty Physician? Impose upon me whatever hardships you please; give me nothing but the bread of sorrow to eat; take from me the friends in whom I had placed my confidence; lay me in the cold hut of poverty, and on the thorny bed of disease; set death before me in all its terrors; do all this,—only let me trust in my Saviour, and "pillow my head on the bosom of Omnipotence," and I will "fear no evil,"—I will rise superior to affliction,"—I will "re-

joice in my tribulation." But let infidelity interpose between God and my soul, and draw its impenetrable veil over a future state of existence, and limit all my trust to the creatures of a day, and all my expectations to a few years as uncertain as they are short; and how shall I bear up with fortitude or with cheerfulness, under the burden of distress? Or where shall I find one drop of consolation to put into the bitter draught which has been given me to drink? I look over the whole range of this wilderness in which I dwell, but I see not one covert from the storm, nor one leaf for the healing of my soul, nor one cup of cold water to refresh me in the weariness and the faintings of my pilgrimage.

ANDREW THOMSON.

On the threatened Invasion in 1803.—BY a series of criminal enterprises, the liberties of Europe have been gradually extinguished; and we are the only people in the eastern hemisphere who are in possession of equal laws and a free constitution. Freedom, driven from every spot on the Continent, has sought an asylum in a country which she always chose for her favourite abode; but she is pursued even here, and threatened with destruction. The inundation of lawless power, after covering the whole earth, threatens to follow us here; and we are most exactly, most critically placed in the only aperture where it can be successfully repelled—in the Thermopylæ of the world. As far as the interests of freedom are concerned—the most important by far of sublunary interests!—you, my countrymen, stand in the capacity of the federal representatives of the human race; for with you it is to determine (under God) in what condition the latest posterity shall be born; their fortunes are intrusted to your care, and on your conduct at this moment depend the colour and complexion of their destiny. If liberty, after being extinguished on the Continent, is suffered to expire here, whence is it ever to emerge in the midst of that thick night that will invest

it? It remains with you then to decide, whether that freedom, at whose voice the kingdoms of Europe awoke from the sleep of ages, to run a career of virtuous emulation in everything great and good; the freedom which dispelled the mists of superstition, and invited the nations to behold their God,—whose magic torch kindled the rays of genius, the enthusiasm of poetry, and the flame of eloquence; the freedom which poured into our lap opulence and arts, and embellished life with innumerable institutions and improvements, till it became a theatre of wonders; it is for you to decide, whether this freedom shall yet survive, or be covered with a funeral-pall, and wrapped in eternal gloom. It is not necessary to await your determination. In the solicitude you feel to approve yourselves worthy of such a trust, every thought of what is afflicting in warfare, every apprehension of danger must vanish, and you are impatient to mingle in the battle of the civilized world. Go then, ye defenders of your country, accompanied with every auspicious omen; advance with alacrity into the field, where God himself musters the host to war. Religion is too much interested in your success not to lend you her aid; she will shed over this enterprise her selectest influence. While you are engaged in the field, many will repair to the closet, many to the sanctuary; the faithful of every name will employ that prayer which has power with God; the feeble hands, which are unequal to any other weapon, will grasp the sword of the Spirit; and from myriads of humble contrite hearts, the voice of intercession, supplication, and weeping, will mingle, in its ascent to heaven, with the shouts of battle and the shock of arms. The extent of your resources, under God, is equal to the justice of your cause. But should Providence determine otherwise, should you fall in this struggle, should the nation fall, you will have the satisfaction (the purest allotted to man!) of having performed your part; your names will be enrolled with the most illustrious dead, while posterity to the end of time, as often as they revolve the events of

this period (and they will incessantly revolve them), will turn to you a reverential eye, while they mourn over the freedom which is entombed in your sepulchre. I cannot but imagine the virtuous heroes, legislators, and patriots, of every age and country, are bending from their elevated seats to witness this contest, as if they were incapable, till it be brought to a favourable issue, of enjoying their eternal repose. Enjoy that repose, illustrious immortals! Your mantle fell when you ascended; and thousands, inflamed with your spirit, and impatient to tread in your steps, are ready to swear by Him that sitteth upon the throne, and liveth for ever and ever, that they will protect Freedom in her last asylum, and never desert that cause which you sustained by your labours and cemented with your blood. ROBERT HALL.

Claims of the Jews.—IN advocating the cause of Israel, I would ask, and strongly too, is the account of *justice* towards that nation settled? Is the long arrear of Gentile *gratitude* to that nation discharged? For to what blessing shall we refer in the long catalogue of our own mercies, which we have not derived from Israel?

Amidst the sorrows and vicissitudes of life, do we find daily consolations from God? Under the terrors of conscience, do we behold a peaceful asylum in the cross of Christ? By the bed of dying worth, or at the oft-frequented grave of departed friendship, do we wipe away our tears in the sure and certain hope of a resurrection to the life eternal? From whence do all these consolations flow? They flow to us from Judah. The Volume of God was penned by Jewish hands—the Gospel was proclaimed by Jewish lips—yea, that Sacred Victim on the cross—the world's only hope—the sinner's only joy—wears not even He the lineaments of the children of Abraham? Christians! at length remove the stigma—repay the debt—admit the claims of justice—yield to the

impulse of gratitude—feel—toil—supplicate for those whose forefathers felt, and toiled, and prayed for you!

Think, my brethren, of all their *former* grandeur, and contrast it with their *present* desolation. Such a contrast raises, even under ordinary circumstances, a keen emotion in the human heart. Why does the traveller fondly linger amidst the scenes of ancient art, or power, or influence? Why for so many a year have the poet and the philosopher wandered amidst the fragments of Athens and of Rome? Why paused, with strange and kindling feelings, amidst their broken columns—their mouldering temples—their deserted plains? It is because their day of glory is passed—it is because their name is obscured—their power is departed, their influence is lost!

Similar emotions have, indeed, been often felt amidst the scenes of Jewish fame. The forsaken banks of Jordan, where the Psalmist once tuned his lyre and uttered his prophetic songs—the blighted plains of Galilee, where the Saviour often bent his lonely steps to cheer the widow's dwelling—the ruined city, once the terror of surrounding nations—the forgotten temple, whose walls once echoed back the accents of that voice "which spake as never man spake"—these images and memorials of former days have often produced a solemn sadness in the minds of those who have visited the shores of Palestine—and these feelings have responded to the affecting complaint, *Thy holy cities are a wilderness—Zion is a wilderness—Jerusalem is a desolation. Our holy and our beautiful house, where our fathers praised thee, is burned up with fire, and all our pleasant things are laid waste.*

But is there no emphasis of sadness to be found in the sordid and degraded state of those who wander through the world forgotten and forlorn, though once the honoured servants, the favoured children of the Lord? Shall the sculptured stone—the broken shaft—the time-worn capital—even the poor fragments of some profane sanctuary—shall these affect so deeply the heart—and shall the moral ruin, the spiritual decay, the symptoms of eternal perdition—shall these vestiges of desolation excite no feeling in our bosoms?

"Oh! where a sight shall shuddering sorrow find
Sad as the ruins of the human mind?"

And where is a ruin to be found so mournful and so complete as that which the moral aspect of Judah now presents to our view? NOEL.

WAR-SONG OF THE GREEKS.

AWAKE! 'tis the terror of war;
  The Crescent is toss'd on the wind;
But our flag flies on high, like the perilous star
  Of the battle. Before and behind,
Wherever it glitters, it darts
Bright death into tyrannous hearts.

Who are they that now bid us be slaves?
  They are foes to the good and the free;
Go bid them first fetter the might of the waves;
  The sea may be conquer'd,—but we
Have spirits untamable still,
And the strength to be free,—and the will.

The Helots are come: In their eyes
  Proud hate and fierce massacre burn,
They hate us,—but shall they despise?
  They are come; shall they ever return?
O God of the Greeks! from thy throne
Look down, and we'll conquer alone.

Our fathers,—each man was a god,
  His will was a law, and the sound
Of his voice, like a spirit's, was worshipp'd: he trod,
  And thousands fell worshippers round:
From the gates of the West to the Sun
He bade, and his bidding was done.

And we—shall we die in our chains,
  Who once were as free as the wind?
Who is it that threatens,—who is it arraigns?
  Are they princes of Europe or Ind?
Are they kings to the uttermost pole?
They are dogs with a taint on their soul.

BARRY CORNWALL.

MINERALS.—DIAMOND, FLINT, ASBESTOS, CLAY-SLATE, COMMON MICA, LIME, ALABASTER, NITRE, AND COAL.

THE most simple and natural division of minerals is into four classes, *stones*, *salts*, *combustibles*, and *metals*. The principal species belonging to the first class are, besides the precious stones, quartz, clay, clay-slate, mica, soap-stone, talc, and lime; those belonging to the second are, alum, common salt, nitre, and sal-ammoniac. And the principal combustibles are, the bituminous substances, naphtha, coal, jet, and sulphur. These species or families, are again subdivided into individuals; but as it is not intended, in this lesson, to give a systematic view of minerals, but merely to give some account of the most curious or useful of them, farther subdivision is unnecessary.

The *Diamond* has the pre-eminence of all precious stones; it is of various colours, though commonly white or gray. In the direct rays of the sun, or in candlelight, it displays, when skilfully cut, the most brilliant play of colours. By modern experiments, it is found, though the hardest of minerals, to be a combustible substance. In addition to its use as an ornament, it is employed by lapidaries for cutting and engraving upon the harder gems, by watchmakers in their finer kind of work, and by glaziers for cutting glass. The largest diamond hitherto discovered is said to be one found in Brazil, now in possession of the royal family of Portugal. Its weight is 1680 carats, and its value upwards of five millions sterling. But it is now believed to be merely a topaz. The Emperor of Russia has in his possession a diamond, perfectly pure, of the weight of 195 carats, and of the size of a pigeon's egg. It represented one of the eyes in a Brahminical image, whence it was stolen by a French grenadier, who, not aware of the prize he had got, sold it much under its value. After passing through three other hands, it was bought by the Empress of Russia for £90,000, ready money, and an annuity of £4000.

Flint, a kind of quartz, is a peculiarly hard and compact stone. It is nearly thrice as heavy as water, and when broken, will split, in every direction, into pieces which have a smooth surface. In consequence of its property of yielding sparks, when struck against steel, it was long an article of indispensable utility in the system of modern warfare. It is also employed in the manufacture of porcelain and glass. Glass is made by mixing the flint, reduced to a fine powder, with a certain proportion of soda or potash, and exposing the compound, thus formed, to a violent heat till it becomes perfectly fluid. It is then, by means of a hollow tube, to which it is attached, blown into moulds of the shape and size of the vessel to be formed.—(*See Illustrations*, *Fig.* 4.)

Asbestos is a greenish or silvery white mineral, of fibrous texture, which is found in many mountainous countries. Its name, signifying that which is inconconsumable, describes its distinguishing property. The ancients made it, particularly a silky variety of it in long slender filaments called *amianthus*, into an incombustible kind of cloth, in which they burned the bodies of their dead in order that they might collect and preserve the ashes without mixture. Pliny, the Roman naturalist, informs us that he had seen tablecloths, towels, and napkins of amianthus taken from the table of a great feast and burned before the company, by which operation, he adds, they became better cleansed than if they had been washed. It is used in modern times principally for the manufacture of gloves, caps, girdles, and purses. It has sometimes been made also into fire-proof paper; and in Corsica it is kneaded with clay for the manufacture of pottery.

Clay-slate is a well-known mineral, of a foliated texture, and of a grayish, black, brown, green, or bluish colour. It breaks into splinters, and is nearly thrice as heavy as water. Its principal use is for the roofing of houses. For this purpose it is split into thin plates, or

laminæ, which are fastened to the rafters by pegs driven through them, and made to lap over each other at the edges in such a manner as to exclude moisture. Dark-coloured and compact slates are manufactured into writing slates. In the preparation of these, the slate, after it is split of a proper thickness, is first smoothed with an iron instrument, then ground with sandstone, and slightly polished with tripoli (a clay of a yellowish-gray colour, which received its name from having been first imported into Europe from Tripoli), and, lastly, rubbed with charcoal powder. The pencils which are used for writing on slates are made of a particular kind of soft slate, which, on splitting, falls into long splintery fragments. When sufficiently solid for the purpose, slate is cut into inkstands, and turned into vases and fancy articles of various kinds. And a singular circumstance has been remarked, that if a window or door be suddenly opened in an apartment where the workmen are turning these, they will sometimes fly in pieces; though, after the work is finished, they may be exposed to the usual changes of temperature without injury.

Common Mica, Glimmer or Muscovy glass, is a mineral of a foliated texture, which is capable of being divided into extremely thin leaves that have a sensible elasticity, and are transparent. Its colour varies from black to silvery white, and it has occasionally a metallic lustre on the surface. It is so soft as easily to be scratched, and, when divided across the plates, seems rather to tear than break. Thin plates of this mineral are adopted, in many parts of Siberia and Muscovy, to supply the place of glass for windows. In the shipping of Russia it is considered preferable to glass, because the concussion produced by the firing of the guns does not shatter it. It may be advantageously substituted for horn in lanterns, as it is not only more transparent, but less susceptible of injury from the flame of the candle. It has, however, the inconvenience of soon becoming dirty, and of having its transparency destroyed by long exposure to the air.

Lime, after it has been freed from extraneous matters by burning, is a mineral of a whitish colour, and pungent, acrid, and caustic taste, which changes vegetable blue colours to green, and corrodes and destroys animal substances. The process of purifying lime is by placing it in a large kind of furnace called a *kiln*, where the limestones and fuel are heaped in alternate layers. After having gone through this process it is commonly known by the name of *quicklime*. The principal use of lime is in the formation of mortar or cement for buildings. For this purpose it is first slacked by having water poured upon it; a violent heat is thereby excited, and the lime falls into powder; it is then formed into paste by working it with water and sand. It is also used for agricultural purposes, being supposed, when laid upon land, to hasten the dissolution and putrefaction of all kinds of animal and vegetable substances, and to impart to it a power of retaining the moisture which is necessary for the vigorous growth of agricultural produce. It is employed likewise in the refining of sugar, in the manufacture of soap, in the melting of iron, and by tanners, in a state of solution, for dissolving the gelatinous parts of skins, and removing the hair from them. If swallowed, or inhaled, it is a violent poison. *Chalk* is a white, earthy kind of limestone too well known to require any description; and *marble* is a close-grained species of the same mineral, so hard as to admit of being polished.

Calcareous Alabaster, which was employed by the ancients for the same purposes as marble, and of which the box of precious ointment mentioned in the Gospel of St Matthew is supposed to have been formed, is a species of limestone deserving of notice chiefly on account of its formation. The water which oozes through the crevices of limestone-rocks becomes strongly impregnated with minute particles of lime. This water, when it has reached the roof or side of a cavern, is generally suspended for a considerable time before a drop of sufficient size to fall by its own weight is formed. In the interval which thus

elapses, some of the particles of lime are separated from the water and adhere to the roof. In this manner successive particles are separated, and are attached to each other, until what is called a *stalactite*, having somewhat the appearance of an icicle, is formed. If the water collects and drops too rapidly to allow time for the formation of a stalactite, it falls upon the floor, and there forms an irregular lump of alabaster, which has the name of *stalagmite*. In some caverns the separation of the calcareous matter takes place both at the roof and on the floor; and in course of time, the substance upon each increasing, they meet, and form pillars, sometimes of great magnitude.—(*See Illustrations, Fig.* 5.)

Nitre, or *Saltpetre*, is usually observed in the form of fine capillary crystals. Its principal use is in the manufacture of gunpowder; and, in order to obtain it in sufficient abundance for this purpose, it is necessary to have recourse to artificial means. In several districts of the East Indies there are places called saltpetre-grounds, from which large quantities of the earth are dug and put into cavities through which water is passed. The water brings away with it the salt contained in the earth, which is afterwards separated from the water by boiling. The East India Company, for more than a century past, has been under engagements to supply the Board of Ordnance for the public service with 500 tons of nitre annually, at given rates and prices in times of peace and war. The discovery of gunpowder has completely changed the art of war. It was first used in Europe in the wars of Germany somewhat before the year 1373; but it is said to have been known in China long anterior to that period. Its component parts are nitre, charcoal, and sulphur, in the proportion, of 76, 15, and 9 in every hundred parts.

Coal, which is composed of charcoal, oxygen, and hydrogen, is the most important of the *combustible* minerals. Its uses as fuel are too well known to require any

observations. In Britain this mineral is found in such abundance, and applied to so many important purposes, that it has been regarded by some foreign writers as the great source of our wealth, and the principal cause of our national prosperity; and indeed there can be no doubt that our superiority to other countries in *arts* and *manufactures* is owing in a great measure to its abundance. The most valuable species of coal are *jet* or *pitch* coal, which is so hard as to resist scratching even by a knife, and is generally made into rosaries, necklaces, snuff-boxes, and other trinkets; *cannel* coal, called in Scotland *parrot* coal, which is highly inflammable, does not soil the fingers, and crackles and splinters during combustion; *glance* coal, which consists almost entirely of charcoal, produces neither smoke nor soot, emits a blue lambent flame when redhot, and gives out an extremely suffocating effluvium; and *common* or *pit* coal, which stains the fingers, and cakes during combustion. Coals are principally obtained from the neighbourhood of Newcastle-upon-Tyne, South Wales, and Lancashire, in England; and in the river-districts of the Forth and Clyde in Scotland. The particular places whence they are obtained have the name of *collieries*, and the mines from which they are dug are called *pits*. The deepest of these are in Northumberland, and are worked at more than 1800 feet below the surface of the earth. At Newcastle there is a coal-pit nearly 800 feet in depth, and which at that depth is wrought five miles horizontally, quite across and beneath the bed of the river Tyne, and under the adjacent part of the county of Durham. At Whitehaven the mines are of great depth, and are extended even under the sea, to places where there is above them sufficient depth of water for ships of great burden, and in which the miners are able sometimes to hear the roaring of the water. On the contrary, in some parts of Durham the coal lies so near the surface of the earth that the wheels of carriages lay it open, and in such quantity as to be sufficient for the use of the neighbourhood.

THE BURIAL OF SIR JOHN MOORE.

Not a drum was heard, not a funeral note,
  As his corse to the rampart we hurried;
Not a soldier discharged his farewell shot
  O'er the grave where our hero we buried.

We buried him darkly at dead of night,
  The sods with our bayonets turning;
By the struggling moonbeam's misty light,
  And the lantern dimly burning.

No useless coffin enclosed his breast,
  Not in sheet or in shroud we wound him;
But he lay like a warrior taking his rest,
  With his martial cloak around him.

Few and short were the prayers we said,
  And we spoke not a word of sorrow;
But we steadfastly gazed on the face that was dead,
  And we bitterly thought of the morrow.

We thought as we hollow'd his narrow bed,
  And smooth'd down his lonely pillow,
That the foe and the stranger would tread o'er his head,
  And we far away on the billow!

Lightly they'll talk of the spirit that's gone,
  And o'er his cold ashes upbraid him,—
But little he'll reck, if they let him sleep on
  In the grave where a Briton has laid him.

But half of our heavy task was done,
  When the clock struck the hour for retiring;
And we heard the distant and random gun
  That the foe was sullenly firing.

Slowly and sadly we laid him down,
  From the field of his fame fresh and gory;
We carved not a line, and we raised not a stone—
  But we left him alone with his glory.

Rev. C. Wolfe.

ATTRACTION OF COHESION AND ATTRACTION OF GRAVITY.

Mrs B. Emily. Caroline.

E. I have related to my sister Caroline all that you taught me yesterday respecting bodies; and she has been

so much delighted by it, that she hopes you will have the goodness to admit her to your lessons.

Mrs B. Very willingly; but I did not think that you had any taste for studies of this nature, Caroline.

C. I confess, Mrs B., that hitherto I had formed no very agreeable idea either of philosophy or philosophers; but what Emily has told me has excited my curiosity so much, that I shall be highly pleased if you will allow me to become one of your pupils.

Mrs B. I fear that I shall not find you so tractable a pupil as Emily; I know that you are much biassed in favour of your own opinions.

C. Then you will have the greater merit in reforming them; and, after all the wonders that Emily has related to me, I think I stand little chance against you and your attractions.

Mrs B. Well, your objections I shall willingly admit, as they will be the means of elucidating the subject. Emily, do you recollect the names of the general properties of bodies?

E. Impenetrability, extension, figure, divisibility, and inertia.

Mrs B. You must remember that these are properties common to all bodies, and of which they cannot be deprived; all other properties are called *accidental*, because they depend on the relation of one body to another.

C. Yet, surely, Mrs B., there are other properties which are essential to bodies besides those you have enumerated. Weight, for instance, is common to all bodies, and does not arise from their connexion with each other, but exists in the bodies themselves.

Mrs B. I beg your pardon; this property does not exist in bodies independently of their connexion with other bodies.

C. What! have bodies no weight? Does not this table weigh heavier than this book? and if one thing weighs heavier than another, must there not be such a thing as weight?

Mrs B. No doubt; but this property does not appear

to be essential to bodies; it depends upon their connexion with each other. Weight is an effect of the power of *attraction*, without which the table and the book would have no weight whatever. Indeed, attraction itself must be considered as an accidental property of matter.

C. But what is attraction, Mrs B.? I do not clearly understand it.

E. Allow me, Mrs B., to explain it to Caroline. All bodies consist of infinitely small particles of matter, each of which possesses the power of attracting, or drawing towards it, any other particle sufficiently near to be within the influence of its attraction; but in minute particles this power extends to so very small a distance that its effect is not sensible, unless they are, or appear to be, in contact. It then makes them stick or adhere together, and is hence called the *attraction of cohesion.* Without this power solid bodies would fall to pieces, or rather crumble to atoms.

C. Well; it never occurred to me that any power was requisite to unite the particles of which solid bodies are composed. But the attraction of cohesion does not, I suppose, exist in liquids; for the particles of liquids do not remain together so as to form a body, unless confined in a vessel.

E. I beg your pardon; it is the attraction of cohesion which holds this drop of water suspended at the end of my finger, and keeps the minute watery particles of which it is composed united. But, as this power is stronger in proportion as the particles of bodies are more closely united, the cohesive attraction of solid bodies is much greater than that of fluids. The thinner and lighter a fluid is, the less is the cohesive attraction of its particles, because they are farther apart; in air, for example, which is a very light and rare fluid, there is almost no attraction among the particles.

C. It is then, I suppose, owing to the different degrees of attraction of different substances that they are hard or soft, and that liquids are thick or thin?

E. Yes. Is it not so, Mrs B.?

Mrs B. Certainly; but you would express your meaning better by the term *density*, which denotes the closeness and compactness of the particles of a body. *Rarity* is used in the same way, though opposed to *density;* thus, you would say, mercury was a very *dense* fluid, ether a very *rare* one.

C. But you were speaking a little ago of the *attraction of gravity.* Is this the same as the attraction Emily has just described?

Mrs B. It is substantially the same; and had you not interrupted your sister, she would have gone on to describe it also. Explain it now, Emily.

E. The attraction of cohesion takes place between bodies only when they are at such very small distances from each other that they appear to the eye to be in contact; but the attraction of *gravitation* or *gravity* is the force which all the masses of matter exert upon each other at all distances.

C. You astonish me; surely you do not mean to say that large bodies attract each other?

Mrs B. Indeed she does, Caroline; let us take, for example, the largest bodies in nature, and observe whether they do not attract other bodies. What is it that occasions the fall of this book when I no longer support it?

C. Can it be the attraction of the earth? I thought that all bodies had a natural tendency to fall.

Mrs B. They have a natural tendency to fall, it is true; but that tendency is produced entirely by the attraction of the earth; the earth, being so much larger than any body on its surface, forces every body, which is not supported, to fall upon it. All matter is attractive, from the smallest particle to the largest mass, and bodies attract each other with a force proportioned to the quantity of matter they contain.

E. Is it not, then, because every particle is endowed with an attractive power, that large bodies, consisting of a great number of particles, are so strongly attractive?

Mrs B. It is; but there is this difference between the attraction of particles and that of masses, that the

former is stronger than the latter in proportion to the quantity of matter. It is from this circumstance that all solid bodies are enabled, by the force of the cohesive attraction of their particles, to resist that of gravity, which would otherwise disunite them, and bring them to a level with the ground, as it does in the case of liquids, whose cohesion is not sufficient to enable them to resist the power of gravity.

E. But, Mrs B., if the attraction of gravity belongs equally to all kinds of matter, it must be mutual between two bodies; and if so, when a stone falls to the earth, the earth should rise part of the way to meet the stone?

Mrs B. Certainly; but you must recollect that the force of attraction is proportioned to the quantity of matter which bodies contain; and if you consider the difference there is, in that respect, between a stone and the earth, you will not be surprised that you do not perceive the earth rise to meet the stone.

E. But since attraction is proportioned to the quantity of matter which bodies contain, why do not the hills attract the houses and churches towards them?

C. Oh, Emily, what an idea! How can the houses and churches be removed when they are so firmly fixed in the ground?

Mrs B. Emily's question is not absurd; and your answer, Caroline, is perfectly just; but can you tell why the houses and churches are so firmly fixed in the ground?

C. I am afraid I have answered right by mere chance; for I begin to suspect that bricklayers and carpenters could give but little stability to their buildings without the aid of attraction.

Mrs B. It is certainly the cohesive attraction between the bricks and the mortar which enables them to build walls; and these are so strongly attracted by the earth as to resist every other impulse. They would necessarily move towards the hills and the mountains, did not the lesser force yield to the greater. There are, however, some circumstances in which the attraction of a large

body has sensibly counteracted that of the earth. If, whilst standing on the declivity of a mountain, you hold a plumb-line in your hand, the weight will not fall perpendicular to the ground, but incline a little toward the mountain.

E. But the size of a mountain is very trifling compared to the whole earth.

Mrs B. Attraction, you must recollect, diminishes with distance; and, in the example of the plumb-line, the weight is considerably nearer to the mountain than to the centre of the earth; then the inclination of the plumb-line is very small, so small that it is not sensible to the eye without the help of instruments contrived for the purpose.

C. Pray, Mrs B., do the two scales of a balance hang parallel to each other?

Mrs B. You mean, I suppose, in other words, to inquire whether two lines, which are perpendicular to the earth, are parallel to each other? I believe I guess the reason of your question; but I wish you would endeavour to answer it without my assistance.

C. I was thinking that such lines must both tend by gravity to the same point, the centre of the earth; now, lines tending to the same point cannot be parallel, as parallels are always at an equal distance from each other, and would never meet.

Mrs B. Very well explained. Lines which fall perpendicular to the surface of a sphere cannot be parallel, because they would all meet if prolonged to the centre of the sphere.—(*See Illustrations, Fig.* 6.)

E. And yet a pair of scales, hanging perpendicular to the earth, appear parallel?

Mrs B. Because the sphere is so large, and the scales consequently converge so little, that their inclination is not perceptible to our senses.

C. It has just occurred to me, that there are some bodies which do not gravitate towards the earth. Smoke and steam, for instance, rise instead of falling.

Mrs B. It is still gravity which produces their ascent; at least were that power destroyed these bodies would not rise.

C. I shall be out of conceit with gravity, if it is so inconsistent in its operations.

Mrs B. There is no difficulty in reconciling this apparent inconsistency of effect. The air near the earth is heavier than smoke, steam, or other vapours; it consequently not only supports these light bodies, but forces them to rise, till they reach a part of the atmosphere the weight of which is not greater than their own, and then they remain stationary. Look at this basin of water; why does the piece of cork which I throw into it float on the surface?

C. Because, being lighter than the water, it is supported by it.

Mrs B. And now, that I pour more water into the basin, why does the cork rise?

C. The water, being heavier than the cork, gets beneath it, and obliges it to rise.

Mrs B. In a similar manner are smoke and vapour forced upwards by the air; but these bodies do not, like the cork, ascend to the surface of the fluid, because, as we observed before, the air being thinner and lighter as it is more distant from the earth, vapours rise only till they attain a region of air of their own density. Smoke, indeed, ascends but a very little way; it consists of minute particles of fuel carried up by a current of heated air from the fire below; and when this current of air is cooled by mixing with that of the atmosphere, the minute particles of coal, or other combustible, fall, and produce the small black flakes which render the air, and everything in contact with it, in London, so dirty.

Mrs Marcet.

SECTION II.

HOW IT STRIKES A STRANGER.

In a remote period of antiquity, when the marvellous obtained a readier credence than now, it was fabled that a stranger of extraordinary appearance was observed pacing the streets of one of the magnificent cities of the East, remarking with an eye of intelligent curiosity every surrounding object. Several individuals gathering round him, questioned him concerning his country and his business; but they presently perceived that he was unacquainted with their language, and he soon discovered himself to be equally ignorant of the most common usages of society. At the same time the dignity and intelligence of his air and demeanour forbade the idea of his being either a barbarian or a lunatic. When at length he understood by their signs that they wished to be informed whence he came, he pointed with great significance to the sky; upon which the crowd, concluding him to be one of their deities, were proceeding to pay him divine honour; but he no sooner comprehended their design, than he rejected it with horror, and, bending his knees, and raising his hands towards heaven in the attitude of prayer, gave them to understand that he also was a worshipper of the powers above.

After a time, it is said that the mysterious stranger accepted the hospitalities of one of the nobles of the city; under whose roof he applied himself with great diligence to the acquirement of the language, in which he made such surprising proficiency, that in a few days he was able to hold intelligent intercourse with those around him. The noble host now resolved to take an early opportunity of satisfying his curiosity respecting the country and quality of his guest; and, upon his expressing

this desire, the stranger assured him that he would answer his inquiries that evening after sunset. Accordingly, as night approached, he led him forth upon the balconies of the palace which overlooked the wealthy and populous city. Innumerable lights from its busy streets and splendid palaces were now reflected in the dark bosom of its noble river; where stately vessels, laden with rich merchandise from all parts of the known world, lay anchored in the port. This was a city in which the voice of the harp and of the viol, and the sound of the millstone, were continually heard; and craftsmen of all kinds of craft were there; and the light of a candle was seen in every dwelling; and the voice of the bridegroom and the voice of the bride were heard there. The stranger mused a while upon the glittering scene, and listened to the confused murmur of mingling sounds. Then suddenly raising his eyes to the starry firmament, he fixed them, with an expressive gaze, on the beautiful evening star. "Marvel not," said he to his host, "that I gaze with fond affection on yonder silvery star. That was my home; yes, I was lately an inhabitant of that tranquil planet; from whence a vain curiosity has tempted me to wander. Often had I beheld with admiration this brilliant world of yours, ever one of the brightest gems of our firmament; and the ardent desire I had long felt to know something of its condition was at length unexpectedly gratified. I received permission and power from above to traverse the mighty void, and to direct my course to this distant sphere. To that permission, however, one condition was annexed, to which my eagerness for the enterprise induced me hastily to consent; namely, that I must thenceforth remain an inhabitant of this strange earth, and undergo all the vicissitudes to which its natives are subject. Tell me, therefore, I pray you, what is the lot of man; and explain to me more fully than I yet understand all that I hear and see around me."

"Truly, sir," replied the astonished noble, "although I am altogether unacquainted with the manners and cus-

toms, products and privileges of your country, yet, methinks, I cannot but congratulate you on your arrival in our world; especially since it has been your good fortune to alight on a part of it affording such various sources of enjoyment as this our opulent and luxurious city. And be assured, it will be my pride and pleasure to introduce you to all that is most worthy the attention of such a distinguished foreigner."

Our adventurer, accordingly, was presently initiated in those arts of luxury and pleasure which were there well understood. He was introduced, by his obliging host, to their public games and festivals, to their theatrical diversions and convivial assemblies; and he was just beginning to be in some measure reconciled to the manners and customs of our planet, strangely as they differed from those of his own, when an incident occurred which gave an entirely new direction to his energies.

It was but a few weeks after his arrival on our earth, when, walking in the cool of the day with his friend in the outskirts of the city, his attention was arrested by the appearance of a spacious enclosure near which they passed. He inquired the use to which it was appropriated.

"It is," replied the nobleman, "a place of public interment."

"I do not understand you," said the stranger.

"It is the place," repeated his friend, "where we bury our dead."

"Excuse me, sir," replied his companion, with some embarrassment, "I must trouble you to explain yourself yet further."

The nobleman repeated the information in still plainer terms.

"I am still at a loss to comprehend you perfectly," said the stranger, turning deadly pale. "This must relate to something of which I was not only totally ignorant in my own world, but of which I have as yet had no intimation in yours. I pray you, therefore, to satisfy

my curiosity; for, if I have any clew to your meaning, this surely is a matter of more mighty concernment than any to which you have hitherto directed me."

"My good friend," replied the nobleman, "you must be indeed a novice amongst us, if you have yet to learn that we must all, sooner or later, submit to take our place in these dismal abodes; nor will I deny that it is one of the least desirable of the circumstances which appertain to our condition; for which reason it is a matter rarely referred to in polished society; and this accounts for your being hitherto uninformed on the subject. But, truly, sir, if the inhabitants of the place whence you came are not liable to any similar misfortune, I advise you to betake yourself back again with all speed; for be assured there is no escape here; nor could I guarantee your safety for a single hour."

"Alas!" replied the adventurer, "I must submit to the conditions of my enterprise, of which, till now, I little understood the import. But explain to me, I beseech you, something more of the nature and consequences of this wondrous metamorphosis, and tell me at what period it most commonly happens to man." While he thus spoke his voice faltered, and his whole frame shook violently; his countenance was pale as death, and a cold dew stood in large drops upon his forehead.

His companion, finding the discourse becoming more serious than was agreeable, declared that he must refer him to the priests for further information, this subject being very much out of his province.

"How!" exclaimed the stranger, "then I cannot have understood you:—do the priests only die?—are not you to die also?"

His friend, evading these questions, hastily conducted his importunate companion to one of their magnificent temples, where he gladly consigned him to the instructions of the priesthood.

The emotion which the stranger had betrayed when he received the first idea of death was yet slight in comparison with that which he experienced as soon as he

gathered from the discourses of the priests some notion of immortality, and of the alternative of happiness or misery in a future state. But this agony of mind was exchanged for transport, when he learned that, by the performance of certain conditions before death, the state of happiness might be secured. His eagerness to learn the nature of these terms excited the surprise and even the contempt of his sacred teachers. They advised him to remain satisfied for the present with the instructions he had received, and to defer the remainder of the discussion till the morrow.

"How!" exclaimed the novice, "say you not that death may come at any hour?—may it not then come this hour?—and what if it should come before I have performed these conditions! Oh! withhold not this excellent knowledge from me a single moment!"

The priests then proceeded to explain their Theology to their attentive auditor; but who shall describe the ecstasy of his happiness when he was given to understand that the required conditions were, generally, of easy and pleasant performance; and that the occasional difficulties or inconveniences which might attend them would entirely cease with the short term of his earthly existence!

From that period, continues the legend, the stranger devoted himself to the performance of those conditions on which he was told his future welfare depended. If ever he was tempted for a moment to violate any of the conditions of his future happiness, he bewailed his own madness with agonizing emotions; and to all the invitations he received from others to do anything inconsistent with his real interests, he had but one answer,—"Oh," he would say, "I am to die!—I am to die!" JANE TAYLOR.

SONG OF THE GREEK BARD.

THE isles of Greece, the isles of Greece!
Where burning Sappho loved and sung,
Where grew the arts of war and peace,—
Where Delos rose and Phœbus sprung!

Eternal summer gilds them yet,
But all, except their sun, is set.

The Scian and the Teian muse,
The hero's harp, the lover's lute,
Have found the fame your shores refuse;
Their place of birth alone is mute
To sounds which echo further west
Than your sires' "Islands of the Blest."

The mountains look on Marathon—
And Marathon looks on the sea;
And, musing there an hour alone,
I dream'd that Greece might still be free;
For, standing on the Persian's grave,
I could not deem myself a slave.

A king sat on the rocky brow
Which looks o'er sea-born Salamis;
And ships, by thousands, lay below,
And men in nations—all were his!
He counted them at break of day—
And when the sun set—where were they?

And where are they? and where art thou,
My country?—On thy voiceless shore
The heroic lay is tuneless now—
The heroic bosom beats no more!
And must thy lyre, so long divine,
Degenerate into hands like mine!

'Tis something in the dearth of fame,
Though link'd among a fetter'd race,
To feel at least a patriot's shame,
Even as I sing, suffuse my face;
For what is left the poet here?
For Greeks a blush—for Greece a tear.

Must *we* but weep o'er days more blest?
Must *we* but blush?—our fathers bled.
Earth! render back from out thy breast
A remnant of our Spartan dead;
Of the Three Hundred grant but three,
To make a new Thermŏpylæ!

What, silent still! and silent all?
Ah! no—the voices of the dead

Sound like a distant torrent's fall,
  And answer, "Let one living head,
But one arise—we come, we come!"
'Tis but the living who are dumb.

In vain—in vain: strike other chords:
  Fill high the cup with Samian wine!
Leave battles to the Turkish hordes,
  And shed the blood of Scio's vine!
Hark! rising to the ignoble call—
How answers each bold bacchanal!

You have the Pyrrhic dance as yet,
  Where is the Pyrrhic phalanx gone?
Of two such lessons, why forget
  The nobler and the manlier one?
You have the letters Cadmus gave—
Think ye he meant them for a slave?

Fill high the bowl with Samian wine!
  We will not think of themes like these;
It made Anacreon's song divine:
  He served—but served Polycrates—
A tyrant; but our masters then
Were still, at least, our countrymen.

The tyrant of the Chersonese
  Was freedom's best and bravest friend;
That tyrant was Miltiades!
  O! that the present hour would lend
Another despot of the kind!
Such chains as his were sure to bind.

Fill high the bowl with Samian wine!
  On Suli's rock, and Parga's shore,
Exists the remnant of a line
  Such as the Doric mothers bore;
And there, perhaps, some seed is sown,
The Heracleidan blood might own.

Trust not for freedom to the Franks—
  They have a king who buys and sells:
In native swords, and native ranks,
  The only hope of courage dwells;
But Turkish force, and Latin fraud,
Would break your shield, however broad.

Fill high the bowl with Samian wine!
  Our virgins dance beneath the shade—
I see their glorious black eyes shine;
  But, gazing on each glowing maid,
My own the burning tear-drop laves,
To think such breasts must suckle slaves.

Place me on Sunium's marbled steep,—
  Where nothing, save the waves and I,
May hear our mutual murmurs sweep;
  There, swan-like, let me sing and die;
A land of slaves shall ne'er be mine—
Dash down yon cup of Samian wine! BYRON.

THE MALLEABLE METALS.

METALS, in a perfect state, are easily distinguished from other minerals, by a peculiar brilliancy which pervades their whole substance, by their complete opacity, and their great weight in proportion to that of other mineral substances. When found in a state of combination with other substances, they have the name of *ores*, and they are in general deposited in veins of various thickness, and at various depths in the earth. The mode of obtaining them is to penetrate from the surface of the earth to the vein, and there to follow it, in whatever direction it may lie. The hollow places thus formed are called *mines*, and the men employed in them are denominated *miners*.—When the veins are at a great depth, or extend to any considerable distance beneath the surface of the earth, it is necessary, at intervals, to make openings or *shafts*, to the surface, for the admission and circulation of the air; and also to draw off the water which collects at the bottom, by drains, pumps, or steam-engines, as the situation or circumstances require. The principle of the *malleable metals*, that is, those metals which are capable of being flattened or elongated by the hammer, without tearing or breaking, are *platina*, *gold*, *mercury*, *silver*, *copper*, *iron*, *tin*, and *lead*.

Platina, one of the most ponderous of metals, is, when purified, twenty-three times heavier than water. It is

of a white colour, but not so bright as silver, and is found sometimes in considerable masses in mines, but generally in small grains in the sands of rivers. If platina could be obtained in sufficient quantity, it would perhaps be the most valuable of all metals. The important uses to which it is applicable may easily be imagined when we state that it is nearly as hard as iron, that the most intense fire and most powerful acids have scarcely any effect upon it, and that it is not fusible by the heat of a forge, but requires either the concentrated rays of the sun in a burning mirror, the galvanic electricity, or a flame produced by the agency of oxygen gas. It is much used for chemical apparatus, and is sometimes made into mathematical instruments, pendulums, and clockwork; particularly where it is requisite that the construction of these should be more than usually correct, as platina is not only free from liability to rust, but is likewise subject to very little dilatation by heat. This extraordinary metal, which ranks next in value to gold, was unknown in Europe until about the year 1735, when it was first brought from South America by Don Antonio Ulloa.

Gold is a metal of a yellow colour. It is next in weight to platina, being nineteen times heavier than water; it is softer than silver, harder than tin, and more easily melted than copper. It is found in various states, —massive, in grains, and in small branches. It cannot be dissolved in any acid except that called aqua regia. Gold is obtained chiefly from South America, Russia, California, and Australia. The mode of extracting it from its ore is by reducing it into a fine powder, and mixing this powder with quicksilver. The latter having the quality of uniting with itself every particle of the precious metal, but being incapable of union with the other substances, extracts it even from the largest portions of earth. The quicksilver, which has absorbed the gold, is then separated by means of heat; it flies off in vapour, and leaves the other metal in the vessel used for the operation.—Gold has been known and in request from the very earliest ages of the world. By the

assent of civilized nations, it has become the representative of wealth under the form of money; and it is also used for goldsmiths' work, in jewellery, and for gilding. In each of these its standard or purity is different. That denominated *coinage*, or *sterling gold*, consists of an alloy of about twenty-two parts of gold with two parts of copper; whilst gold of the *new standard*, of which gold plate, watch-cases, and many other articles, are made, consists of only eighteen parts of gold and six parts of copper. Each of these is stamped at Goldsmiths' Hall; the former with a lion, a leopard's head (the mark of the Goldsmiths' Company), a letter denoting the year, the sovereign's head, and the manufacturer's initials; the latter is stamped with the sovereign's head, the letter for the year, a crown, the number 18 to designate its quality, and the manufacturer's initials. The coinage-gold of Portugal and America is of the same standard as our own; that of France is somewhat inferior; and Spanish gold is inferior to the French. The Dutch ducats and some of the Moorish coins are of gold unalloyed. *Trinket-gold*, which is unstamped, is in general much less pure than any of the above; and the *pale gold* which is used by jewellers is an alloy of gold with silver.—The ductility and tenacity of this metal, particularly when alloyed with copper, are extremely remarkable, and are fully proved by the great extent to which a very small quantity of it may be beaten into leaves, or drawn into wire. Leaves of gold may be beaten so thin, that a single grain may be made into fifty-six leaves, each an inch square. These leaves are only $\frac{1}{282000}$ of an inch thick; and the gold leaf which is used to cover silver wire is but the twelfth part of that thickness. An ounce of gold upon silver wire is capable of being extended more than 1300 miles in length; and nineteen ounces of gold, which in the form of a cube would not measure more than an inch and a quarter on each side, will completely gild a silver wire in length sufficient to compass the whole earth like a hoop.

Mercury, in its native state, is called quicksilver, and is found in small globules of shining, silvery appearance, scattered through different kinds of stones, clay, and ores. It is nearly fourteen times heavier than water. The principal ore of mercury, and that from which the metal is chiefly obtained, is *cinnabar*. This is of a red colour, and consists of mercury mineralized with sulphur. It is sometimes found in a massive state, sometimes in grains, and sometimes crystallized, and chiefly among rocks of the coal-formation. The most productive mines of cinnabar are in the Palatinate in Germany, at Idria in Carniola, and at Almaden in Spain. Those of Idria are supposed to be more valuable than any of the others. Their first discovery, which was more than three hundred years ago, was made in a very extraordinary manner. This part of the country was then much inhabited by coopers; and one of the men, on retiring from work in the evening, placed a new tub under a dropping spring, to try if it would hold water; and when he came in the morning, he found it so heavy that he could scarcely move it. Examining into the cause of this extraordinary circumstance, the man observed that it was owing to a shining and ponderous fluid which was at the bottom. The affair was noised abroad, and a society of persons was formed to search further and discover the mine from which this quicksilver had flowed. Such was their success, that the reigning duke of Austria paid them a compensation for the discovery, and took the mine into his own possession. The greatest perpendicular depth of this mine is now more than 830 feet. It is descended by buckets, or by ladders placed obliquely in a zigzag direction. In some parts of the mine the pure metal flows in small streams, so that in six hours a man has been known to collect more than thirty-six pounds weight of it. In other parts it is found in a multitude of little drops, either in ores or in clay. The whole produce of the mine is said to exceed a hundred tons weight of mercury per annum. It is the singular property of this metal, which

has no other alliance whatever with silver than its appearance, to be capable of division, by the least effort, into an indefinite number of particles, each of which assumes a spherical form, and to be always in a fluid state in the common temperature of our atmosphere. Even during intense frost it still retains its fluidity; but it has lately been observed, in the North Polar regions, to become solid; and it may also be congealed by extreme cold artificially produced; —in which state it may, like the common metals, be beaten with a hammer and extended without breaking; but care must be taken that it does not touch the fingers, as it would blister them and cause unpleasant sores, in the same manner as any burning substance. Being the heaviest of all fluids of which we have any knowledge, and not congealing in the temperature of our climate, it has been preferred, before all others, for barometers, as a measure of the weight of the atmosphere. And as heat dilates mercury similarly to other fluids, it is likewise made into thermometers.

Silver is a white, brilliant, sonorous, and ductile metal, somewhat more than ten times heavier than water. It is found in different states. Of these the principal is denominated *native* silver, from its being nearly in a state of purity. Native silver sometimes occurs in small lumps, sometimes in a crystallized form, and sometimes in leaves, threads, or wire. In many instances the latter are so connected with each other as to resemble the branches of trees, in which case the ore is called *dendritic*. There are also several ores of silver, in which this metal is combined with lead, antimony, arsenic, sulphur, and other substances. The silver that is produced from the mines of Potosi, in South America, is of the dendritic kind; and is considered by the Spaniards as the purest that is known. A range of mountains near Potosi, about twenty miles in circumference, is said to be perforated by more than 300 shafts, or openings of mines, and to produce, in the whole, from 30,000 to 40,000 dollars' worth of ore per week. The annual produce of all the silver mines in America has been estimated at near £2,400,000 ster-

ling. This metal ranks next in value to platina. Like gold, it is coined into money, and is manufactured into various kinds of utensils, such as goblets, vases, spoons, and dishes, which have the general appellation of *silver plate.* For all these purposes it is alloyed with copper, which does not affect its whiteness, and is not easily detected, unless it be in too great proportion; the intention of this is to render it harder than it would otherwise be, and thereby the better to adapt it to receive fine and sharp impressions on being cast. Our *standard silver* is composed of somewhat more than $12\frac{1}{4}$ parts of pure metal and one part of copper; and the metal of this standard is used both for silver plate and in the coinage. The mark or stamp which is given to it at the Goldsmiths' Hall is similar to that which has been explained for sterling gold.—Silver is nearly as ductile as gold. It may be beaten into leaves so thin that a single grain in weight will cover a space of more than fifty-one inches; and it may be drawn into wire much finer than a human hair, indeed so fine that a single grain of silver has, in this form, been extended nearly to the length of 400 feet. It is this wire gilded that has the name of gold wire; and what is denominated *gold lace* is but flattened silver thread gilt, twisted round silk, and woven.

Copper is a red or orange-coloured metal, about nine times heavier than water. It is the most sonorous of all metals, and, except iron, the most elastic. It is found under a great variety of forms, sometimes in masses of pure metal, but more frequently in combination with other substances, particularly sulphur. There are valuable copper mines in every quarter of the world; and the use of copper is probably of greater antiquity than that of any other metal. It is mentioned in the Old Testament; and, at a very early period, domestic utensils and instruments of war were made of bronze, or a compound of copper and tin. Even during the Trojan war, as we learn from Homer, the combatants had no other armour than what was made of bronze. The uses of copper are

numerous and important. When rolled into sheets, betwixt large iron cylinders, it is employed for the covering of houses, sheathing the bottoms of ships, and other purposes. As a covering for houses, copper is lighter than slate, but whether it be more durable has not been yet ascertained. The coppering of ships tends to facilitate their progress through the water, by presenting a smoother surface than that of wood, and not permitting shell-animals to fasten to it as they do to wood. It likewise preserves the bottoms of the ships from being punctured by marine worms; and consequently secures to them a longer duration than they would otherwise have. Plates of copper are also used by artists for engraving pictures upon, either by cutting them with a sharp steel instrument, or corroding them with aquafortis, in lines drawn by a needle through a thin coat of wax spread upon their surface; and this metal likewise is manufactured into various kinds of cooking utensils. Great care, however, ought to be taken, that acid liquors, or even water intended for drinking, or to be mixed with food, be not suffered to stand long in such vessels, otherwise they will dissolve so much of the metal as to give them disagreeable and even poisonous qualities. All vessels formed of this metal which are employed in cookery, ought to have their inner surface covered with a coat of tin. Of all metals, copper is the most susceptible of alloy. *Prince's Metal*, or *Pinchbeck*, is an alloy containing three parts of zinc and four of copper. *Bronze* and *the metal of which cannons are made* consist of from six to twelve parts of tin combined with 100 parts of copper. *Bell-metal*, or the metal of which bells are formed, is usually composed of three parts of copper and one of tin.

Iron is a metal of a livid grayish colour, hard and elastic, and capable of receiving a high polish. Its weight is nearly eight times as great as that of water. Of all the metals there is none which, on the whole, is so useful, or is so copiously and variously dispersed as iron. Indeed its value is beyond all estimate,—infinitely greater

than even that of gold. By means of it the earth has been cultivated and subdued; and without it, houses, cities, and ships, could not have been built, the arts practised, science advanced, or man civilized. Its uses were ascertained at a very early period of the world. Moses speaks of furnaces for iron, and of the ores from which it was extracted, and tells us that swords, knives, axes, and instruments for cutting stones, were, in his time, all made of this metal. The most considerable iron mines at present existing are those in Great Britain and France. After iron ore is dug out of the earth, it is crushed or broken into small pieces by machinery. It is next washed, to detach the grosser particles of earth which adhere to it. This operation ended, it is roasted in kilns formed for the purpose, by which the sulphur, and some other substances that are capable of being separated by heat, are detached. It is then thrown into a furnace, mixed with a certain portion of limestone and charcoal, to be melted. Near the bottom of the furnace there is a taphole, through which the liquid metal is discharged into furrows made in a bed of sand. The larger masses, or those which flow into the main furrow, are called *sows;* the smaller ones are denominated *pigs* of iron; and the general name of the metal in this state is *cast iron.* With us iron is employed in three states,—of cast iron, wrought iron, and steel.

Cast Iron is distinguishable by its properties of being, in general, so hard as to resist both the hammer and the file; being extremely brittle, and, for the most part, of a dark-gray or blackish colour:—and a great number of useful and important articles are formed of it, such as grates, chimney-backs, pots, boilers, pipes, and cannon-shot; all of which are made by casting ladlefuls of the liquid metal into moulds that are shaped for the purpose in sifted sand. The process of converting cast iron into *wrought* or *maleable iron* is called *blooming.* The cast iron is thrown into the furnace, and kept melted by the flame of combustibles, which is made to play upon its surface. Here it is suffered to continue for about two hours, a

workman constantly stirring it, until, notwithstanding the continuance of the heat, it gradually acquires consistency and congeals. It is then taken out while hot, and violently beaten with a large hammer worked by machinery. In this state it is formed into bars for sale.

Steel is usually made by a process called *cementation.* This consists in keeping bars of iron in contact with powdered charcoal, during a state of ignition, for several hours, in earthen troughs or crucibles, the mouths of which are stopped up with clay. Steel, if heated to redness, and suffered to cool slowly, becomes soft; but if plunged, whilst hot, into cold water, it acquires extreme hardness. It may be rendered so hard as even to scratch glass, and at the same time it becomes more brittle and elastic than it was before. Although thus hardened, it may have its softness and ductility restored, by being again heated, and suffered to cool slowly. A piece of polished steel, in heating, assumes first a straw-yellow colour, then a lighter yellow, next becomes purple, then violet, then red, next deep blue, and last of all bright blue. At this period it becomes redhot, the colours disappear, and metallic scales are formed upon and incrust its surface. All these different shades of colour indicate the different tempers that the steel acquires by the increase of heat, from that which renders it proper for files, to that which fits it for the manufacture of watch-springs. Mr Stoddart has availed himself of this property to give to surgical and other cutting instruments those degrees of temper which their various uses require. All kinds of edge-tools, where excellence is required, are made of steel; and a steel instrument may be immediately known from an iron one, by letting fall upon it a drop of aquafortis somewhat diluted with water. If it be steel, this will occasion a black spot; but if it be iron, it will not have this effect.

Meteoric Stones and *Loadstones* are species of iron ore.

Tin is a white metal, somewhat like silver in ap-

pearance, but it is considerably lighter — being only seven times heavier than water—and makes a crackling noise when bent. It is very soft and ductile, and has but little elasticity. The principal tin-mines which are known to us are those of Cornwall, Devonshire, Germany; the island of Banca and peninsula of Malacca in India; and Chili and Mexico in America. Of these the most celebrated are the mines of Cornwall, which are known to have been worked before the commencement of the Christian era. When the tin-ore has been dug from the earth, it is thrown into heaps, and broken to pieces. After this it is washed, and subsequently roasted in an intense heat, for the purpose of dissipating some of the substances with which it is combined. It is lastly melted in a furnace, and thereby reduced to a metallic state. The metal is then poured into quadrangular moulds of stone, each containing about 320 pounds weight. These have the denomination of *block-tin.*

The article usually called *tin*, or *tin-plate*, and in Scotland *white-iron*, of which saucepans, boilers, drinking vessels, and other utensils of domestic economy are made, consists only of thin iron plate coated with tin. It is thus formed:—The iron plates are immersed in water rendered slightly acid by spirit of salt or spirit of vitriol; after which, to clean them completely, they are scoured quite bright. These plates are then each dipped into a vessel filled with melted tin, the surface of which is covered with suet, pitch, or resin, to prevent the formation of dross upon it. The tin not only covers the surface of the iron, but completely penetrates it; giving to its whole substance a white colour. Sheet-iron is usually tinned before, but copper always after it has been formed into utensils. The object to be attained by the tinning of copper is to prevent the vessels made of that metal from being corroded, and to preserve the food prepared in them from being mixed with any particles of that poisonous

substance called verdigris, which is formed by such corrosion.

Lead is a heavy metal, of pale and livid gray colour when broken, not sonorous when pure, very flexible, and so soft that it may be marked with the nail. It stains paper or the fingers of a bluish colour, and is more than eleven times heavier than water. The most common state in which lead is found is in combination with sulphur and a small portion of silver. This ore is known by the name of *galena*, and is frequently in the form of blackish cubical crystals. Great Britain possesses the most important lead-mines in the world; and those that are best known are in the counties of Flint and Derby in England, and in Lanarkshire in Scotland. When the ore is brought out of the mine it is sorted and washed, to free it from dirt and rubbish. After this it is spread on a board; the best pieces are picked out and separated; and those containing ore, mixed with spar or other substances, are placed separate, to be again broken, and again picked. After the ore, by picking and washing, has been sufficiently cleansed from extraneous matters, it is roasted in a kind of kiln to free it from the sulphur that is combined with it. The next process is to mix it with a certain quantity of coke, charcoal, or peat, and submit it to the smelting-furnace. In this furnace there are tap-holes which, when the lead is melted, are opened, and the metal, in a fluid state, runs into a large iron pan. The dross which floats on its surface is now skimmed off; and the metal is taken out by ladles, and poured into cast-iron moulds, with round ends. The lead thus formed is ready for use, and has the name of *pig-lead*. According to their size, the pieces that are thus cast have the appellation of *pigs* and *half-pigs*. Lead is much employed in the useful arts. When rolled between iron cylinders to a requisite state of thinness and uniformity, it is used for the covering of houses and churches, notwithstanding the danger, in case of fire, to persons within, who are exposed to a shower of burning metal. It is cast into pipes, cis-

terns, and reservoirs for water, as well as into large boilers for chemical purposes. But all culinary or domestic vessels made of lead, particularly if intended for the keeping of acid liquors, should carefully be avoided, as the surface of the lead is thereby corroded, and the liquid contained in them is rendered poisonous. Great quantities of lead are also consumed for the making of *shot.* For this purpose the metal is alloyed with arsenic, to render it more brittle, and to render the grains more round and perfect than they otherwise would be. Shot is formed by dropping the melted alloy into water, through an iron or copper frame, perforated with round holes, according to the size required. For the smallest shot the elevation is about ten feet above the water, and for the largest about a hundred and fifty feet.

Abridged from BINGLEY'S *Useful Knowledge.*

DETACHED SELECTIONS FROM SHAKSPEARE.

HEAVEN doth with us as we with torches do:
Not light them for themselves: for if our virtues
Did not go forth of us, 'twere all alike
As if we had them not. Spirits are not finely touch'd,
But to fine issues. Nature never lends
The smallest scruple of her excellence;
But, like a thrifty goddess, she determines
Herself the glory of a creditor,
Both thanks and use.

Now, by two-headed Janus,
Nature hath framed strange fellows in her time:
Some that will evermore peep through their eyes,
And laugh, like parrots, at a bagpiper;
And others of such vinegar aspect,
That they'll not show their teeth in way of smile,
Though Nestor swear the jest be laughable.

THE quality of mercy is not strain'd;
It droppeth as the gentle rain from heaven,

Upon the place beneath: it is twice bless'd;
It blesseth him that gives and him that takes:
'Tis mightiest in the mightiest; it becomes
The throned monarch better than his crown:
His sceptre shows the force of temporal power,
The attribute to awe and majesty,
Wherein doth sit the dread and fear of kings;
But mercy is above this sceptred sway;
It is enthroned in the hearts of kings;
It is an attribute to God himself;
And earthly power doth then show likest God's
When mercy seasons justice.

How sweet the moonlight sleeps upon this bank!
Here will we sit, and let the sounds of music
Creep in our ears; soft stillness, and the night,
Become the touches of sweet harmony.

'Tis the mind that makes the body rich:
And as the sun breaks through the darkest clouds,
So honour peereth in the meanest habit.
What! is the jay more precious than the lark,
Because his feathers are more beautiful?
Or is the adder better than the eel,
Because his painted skin contents the eye?
O, no, good Kate; neither art thou the worse
For this poor furniture and mean array.

Hear him but reason in divinity,
And, all-admiring, with an inward wish
You would desire the king were made a prelate:
Hear him debate of commonwealth affairs,
You would say,—it hath been all-and-all his study:
List his discourse of war, and you shall hear
A fearful battle render'd you in music:
Turn him to any cause of policy,
The Gordian knot of it he will unloose
Familiar as his garter; that, when he speaks,
The air, a charter'd libertine, is still,
And the mute wonder lurketh in men's ears,
To steal his sweet and honeyed sentences.

So may he rest; his faults lie gently on him!
Yet thus far, Griffith, give me leave to speak him,
And yet with charity,—He was a man
Of an unbounded stomach, ever ranking
Himself with princes; one that by suggestion
Tied all the kingdom; simony was fair play;
His own opinion was his law; in the presence
He would say untruths; and be ever double,
Both in his words and meaning; he was never,
But where he meant to ruin, pitiful:
His promises were, as he then was, mighty;
But his performance, as he is now, nothing.
Of his own body he was ill, and gave
The clergy ill example.

Grif. Noble Madam,
Men's evil manners live in brass; their virtues
We write in water.

This cardinal,
Though from an humble stock, undoubtedly
Was fashion'd to much honour. From his cradle
He was a scholar, and a ripe and good one;
Exceeding wise, fair spoken, and persuading;
Lofty and sour to them that loved him not;
But, to those men that sought him, sweet as summer;
And though he were unsatisfied in getting,
(Which was a sin), yet in bestowing, madam,
He was most princely. Ever witness for him
Those twins of learning that he raised in you,
Ipswich and Oxford! one of which fell with him,
Unwilling to outlive the good that did it;
The other, though unfinish'd, yet so famous,
So excellent in art, and still so rising,
That Christendom shall ever speak his virtue:
His overthrow heap'd happiness upon him;
For then, and not till then, he felt himself,
And found the blessedness of being little:
And, to add greater honours to his age
Than man could give him, he died fearing God.

EUROPEAN SCENES.

A Winter Landscape in Russia.—NOTHING interesting

presenting itself, we travelled onwards, through towns and villages, and over a dreary country rendered ten thousand times more so by the season. All around was a vast wintry flat; and frequently not a vestige of man or of cultivation was seen, not even a solitary tree, to break the boundless expanse of snow. Indeed, no idea can be formed of the immense plains we traversed, unless you imagine yourself at sea, far, far from the sight of land. The Arabian deserts cannot be more awful to the eye than the appearance of this scene. Such is the general aspect of the country during the rigours of winter, with now and then an exception of a large forest skirting the horizon for a considerable length of way. At intervals, as you shoot along, you see openings amongst its lofty trees, from which emerge picturesque groups of natives and their one-horse sledges, whereon are placed the different articles of commerce, going to various parts of this empire. They travel in vast numbers, and from all quarters, seldom fewer than one hundred and fifty in a string, having a driver to every seventh horse. The effect of this cavalcade at a distance is very curious; and in a morning, as they advance towards you, the scene is as beautiful as striking. The sun, then rising, throws his rays across the snow, transforming it to the sight into a surface of diamonds. From the cold of the night every man and horse is incrusted with these frosty particles; and the beams falling on them too, seem to cover their rude faces and rugged habits with a tissue of the most dazzling brilliants. The manes of the horses, and the long beards of the men, from the quantity of congealed breath, have a particularly glittering effect.

Sir R. K. PORTER.

Moscow.—WE arrived at the season of the year in which this city is most interesting to strangers. Moscow is in everything extraordinary; as well in disappointing expectation as in surpassing it; in causing wonder and derision, pleasure and regret. Let me conduct the reader back with me again to the gate by which we entered, and

thence through the streets. Numerous spires, glittering with gold, amidst burnished domes and painted palaces, appear in the midst of an open plain, for several versts before you reach the gate. Having passed, you look about and wonder what is become of the city, or where you are, and are ready to ask, once more, How far is it to Moscow? They will tell you, "This is Moscow!" and you behold nothing but a wide and scattered suburb, huts, gardens, pigsties, brick walls, churches, dunghills, palaces, timber-yards, warehouses, and a refuse, as it were, of materials sufficient to stock an empire with miserable towns, and miserable villages. One might imagine all the states of Europe and Asia had sent a building, by way of representative, to Moscow; and under this impression the eye is presented with deputies from all countries, holding congress: timber huts from regions beyond the Arctic: plastered palaces from Sweden and Denmark, not whitewashed since their arrival; painted walls from the Tyrol; mosques from Constantinople; Tartar temples from Bucharia; pagodas, pavilions, and verandas, from China; cabarets from Spain; dungeons, prisons, and public offices from France; architectural ruins from Rome; terraces and trellisses from Naples; and warehouses from Wapping.

Having heard accounts of its immense population, you wander through deserted streets. Passing suddenly towards the quarter where the shops are situated, you might walk upon the heads of thousands. The daily throng is there so immense, that, unable to force a passage through it, or assign any motive that might convene such a multitude, you ask the cause, and are told that it is always the same. Nor is the costume less various than the aspect of the buildings; Greeks, Turks, Tartars, Cossacks, Chinese, Muscovites, English, French, Italians, Poles, Germans, all parade in the habits of their respective countries. Dr E. D. CLARKE.

Mount Etna.—THIS single mountain contains an epitome of the different climates throughout the world, pre-

senting at once all the seasons of the year, and all the varieties of produce. It is divided into three distinct zones or regions, which are known by the names of the cultivated region, the woody or temperate region, and the frigid or desert region. The former of these extends through twelve miles of the ascent towards the summit, and is almost incredibly abundant in pastures and fruit-trees of every description. It is covered with towns, villages, and monasteries; and the number of inhabitants distributed over its surface is estimated at 120,000. In ascending to the woody or temperate region, the scene changes; it is a new climate, a new creation. Below, the heat is suffocating; but here the air is mild and fresh. The turf is covered with aromatic plants; and gulfs, which formerly ejected torrents of fire, are changed into woody valleys. The last, or desert region, commences more than a mile above the level of the sea. The lower part is covered with snow in winter only; but on the upper half of this sterile district the snow constantly lies :—

> Sometimes the pencil, in cool airy halls,
> Bade the gay bloom of vernal landscapes rise,
> Or Autumn's varied shades imbrown the walls:
> Now the black tempest strikes the astonish'd eyes,
> Now down the steep the flashing torrent flies;
> The trembling sun now plays o'er ocean blue,
> And now rude mountains frown amid the skies;
> Whate'er Lorraine light-touch'd with softening hue,
> Or savage Rosa dash'd, or learned Poussin drew.
>
> THOMSON.

On the vastness and beauty of the prospect from the summit of Etna, all authors agree. M. Houel was stationed there at sunrise, when the horizon was clear, and without a single cloud. The coast of Calabria was, he says, undistinguishable from the adjoining sea; but in a short time a fiery radiance began to appear from behind those Italian hills which bounded the eastern part of the prospect. The fleecy clouds, which generally appear early in the morning, were tinged with purple: the atmosphere became strongly illuminated, and, reflecting the

rays of the sun, seemed to be filled with a bright refulgence of flame. Although the heavens were thus enlightened, the sea still retained its dark azure, and the fields and forests did not yet reflect the rays of the sun. The gradual rising of this luminary, however, soon diffused light over the hills which lie below the peak of Etna. This last stood like an island in the midst of the ocean, with luminous points multiplying every moment around, and spreading over a wider extent with the greatest rapidity. It was, said he, as if the world had been observed suddenly to spring from the night of non-existence. The most sublime object, however, which the summit of Etna presents, is the immense mass of its own colossal body. Its upper region exhibits rough and craggy cliffs, rising perpendicularly, fearful to the view, and surrounded by an assemblage of fugitive clouds, to increase the wild variety of the scene. Amid the multitude of woods in the middle or temperate region are numerous mountains, which, in any other situation, would appear of a gigantic size, but which, compared to Etna, are mere molehills. Lastly, the eye contemplates with admiration the lower region, the most extensive of the three, adorned with elegant villas and castles, verdant hills and flowery fields, and terminated by the extensive coast, where, to the south, stands the beautiful city of Catania, to which the waves of the neighbouring sea serve as a mirror.

CLARKE'S *Wonders of the World.*

The Alps.—WHO first beholds the Alps—that mighty chain
Of mountains stretching on from east to west,
So massive, yet so shadowy, so ethereal,
As to belong rather to heaven than earth—
But instantly receives into his soul
A sense, a feeling that he loses not,
A something that informs him 'tis a moment
Whence he may date henceforward and for ever?
To me they seem'd the barriers of a world,
Saying, Thus far, no farther! and as o'er

The level plain I travell'd silently,
Nearing them more and more, day after day,
My wandering thoughts my only company,
And they before me still, oft as I look'd,
A strange delight mingled with fear came o'er me,
A wonder as at things I had not heard of!
Oft as I look'd, I felt as though it were
For the first time!

Great was the tumult there,
Deafening the din, when in barbaric pomp
The Carthaginian on his march to ROME
Enter'd their fastnesses. Trampling the snows,
The war-horse rear'd! and the tower'd elephant
Upturn'd his trunk into the murky sky,
Then tumbled headlong, swallow'd up and lost,
He and his rider.

Now the scene is changed
And o'er Mount Cenis, o'er the Simplon winds
A path of pleasure. Like a silver zone
Flung about carelessly, it shines afar,
Catching the eye in many a broken link,
In many a turn and traverse as it glides;
And oft above and oft below appears,
Seen o'er the wall by him who journeys up,
As though it were another, not the same,
Leading along he knows not whence or whither.
Yet through its fairy course, go where it will,
The torrent stops it not, the rugged rock
Opens and lets it in; and on it runs,
Winning its easy way from clime to clime
Through glens lock'd up before.

Not such *my* path!
Mine, but for those, who, like Jean Jaques, delight
In dizziness, gazing and shuddering on
Till fascination comes and the brain turns!
Mine, though I judge but from my ague-fits
Over the Drance, just where the Abbot fell,
The same as Hannibal's.

But now 'tis past,
That turbulent Chaos; and the promised land

Lies at my feet in all its loveliness!
To him who starts up from a terrible dream,
And lo, the sun is shining, and the lark
Singing aloud for joy, to him is not
Such sudden ravishment as now I feel
At the first glimpses of fair ITALY. RODGERS.

Thunder-Storm among the Alps.

THE sky is changed!—and such a change! Oh night,
And storm, and darkness, ye are wondrous strong,
Yet lovely in your strength, as is the light
Of a dark eye in woman! Far along
From peak to peak, the rattling crags among,
Leaps the live thunder! not from one lone cloud,
But every mountain now hath found a tongue,
And Jura answers, through her misty shroud,
Back to the joyous Alps, who call to her aloud!

And this is in the night: most glorious night!
Thou wert not sent for slumber! let me be
A sharer in thy fierce and far delight,—
A portion of the tempest and of thee!
How the lit lake shines, a phosphoric sea,
And the big rain comes dancing to the earth!
And now again 'tis black—and now the glee
Of the loud hill shakes with its mountain mirth,
As if they did rejoice o'er a young earthquake's birth.

BYRON.

Pompeii.—THE shroud of years thrown back, thou dost revive,
Half-raised, half-buried, dead, yet still alive!
Gathering the world around thee, to admire
Thy disinterment, and with hearts on fire,
To catch the form and fashion of the time
When Pliny lived and thou wert in thy prime;
So strange thy resurrection, it may seem
Less waking life than a distressful dream.

Hush'd is this once-gay scene, nor murmurs more
The city's din, the crowd's tumultuous roar,

The laugh convivial, and the chiming sound
Of golden goblets with Falernian crown'd;
The mellow breathings of the Lydian flute,
And the sweet drip of fountains as they shoot
From marble basements,—these, all these are mute.
Closed are her springs, unnumber'd fathoms deep,
Her splendid domes are one dismantled heap,
Her temples soil'd, her statues in the dust.
Her tarnish'd medals long devour'd by rust;
Its rainbow-pavements broken from the bath,
The once-throng'd Forum—an untrodden path;
The fanes of love—forgotten cells; the shrines
Of vaunted gods—inurn'd in sulphur-mines;
The abodes of art, of luxury, and taste—
Tombs of their once-glad residents—a waste,
O'er which compassionate years have gradual thrown
The trailing vine, and bade the myrtle moan.

LYRICAL GEMS.

Greece.—CLIME of the unforgotten brave!
Whose land from plain to mountain-cave
Was Freedom's home or Glory's grave—
Shrine of the mighty! can it be,
That this is all remains of thee?
Approach, thou craven crouching slave—
Say, is not this Thermopylæ?
These waters blue that round you lave,
Oh servile offspring of the free—
Pronounce what sea, what shore is this?
The gulf, the rock of Salamis!
These scenes—their story not unknown—
Arise, and make again your own;
Snatch from the ashes of your sires
The embers of their former fires,
And he who in the strife expires
Will add to theirs a name of fear,
That tyranny shall quake to hear,
And leave his sons a hope, a fame,
They too will rather die than shame;
For Freedom's battle once begun,
Bequeath'd by bleeding Sire to Son,
Though baffled oft is ever won.

Bear witness, Greece, thy living page,
Attest it many a deathless age;
While kings in dusty darkness hid
Have left a nameless pyramid,
Thy heroes—though the general doom
Hath swept the column from their tomb,
A mightier monument command,
The mountains of their native land!
There points thy Muse to stranger's eye
The graves of those that cannot die!
'Twere long to tell, and sad to trace,
Each step from splendour to disgrace;
Enough—no foreign foe could quell
Thy soul, till from itself it fell;
Yes, self-abasement paved the way
To villain-bonds and despot-sway. BYRON.

Sparta.—THE best geographical works apprize the reader that Misitra is not ancient Lacedæmon; but I had forgotten the circumstance. Judge then of my embarrassment when, from the top of the castle of Misitra, I persisted in the attempt to discover the city of Lycurgus in a town absolutely modern. "This Misitra," said I to the Cicerone, "is Lacedæmon, is it not?"—"Signor; Lacedæmon? What did you say?" rejoined he. "Is not this Lacedæmon, or Sparta?"—"Sparta; what do you mean?"—"I ask you if Misitra is Sparta?"—"I don't understand you."—"What! you a Greek, you a Lacedæmonian, and not know the name of Sparta?"—"Sparta! O yes! great republic; celebrated Lycurgus."—"Is Misitra then Lacedæmon?" The Greek nodded in affirmation. I was overjoyed. "Now," I resumed, "explain to me what I see. What part of the town is that?" I pointed at the same time to the quarter before me a little to the right. "Mesochorion," answered he. "That I know perfectly well; but what part of Lacedæmon was it?"—"I don't know." I was beside myself! "At least show me the river," cried I, and repeated, "Potamos, Potamos!" My Greek pointed to the stream called the Jews' River. "What, is that

the Eurotas! Impossible! Tell me where is the Vasilipotamos?" The Cicerone, after many gestures, pointed to the right towards Amyclæ. "Where then is Sparta? Have I come so far without being able to discover it? Must I return without beholding its ruins?" I was heartily vexed. As I was going down from the castle, the Greek exclaimed, "Your Lordship, perhaps, means Palæochori?" At the mention of this name I recollected the passage of D'Anville, and cried out in my turn, "Yes; Palæochori! the old city, where is that?—Where is Palæochori?"—"Yonder, at Magoula," said the Cicerone, pointing to a white cottage with some trees about it, at a considerable distance in the valley. Tears came into my eyes when I fixed them on this miserable hut, erected on the forsaken site of one of the most renowned cities of the universe, now the only object that marks the spot where Sparta flourished, the solitary habitation of a goatherd, whose whole wealth consists in the grass that grows upon the graves of Agis and of Leonidas. CHATEAUBRIAND.

Grecian Scenery.—WE passed *Macronisi*, once called Helena, because *Helen* is said to have landed here, after her expulsion from Troy; and we had such a glorious prospect of this island, and of the temple of *Minerva Sunias* standing upon the Cape, together with other distant objects, that we could recollect nothing like it: such a contrast of colours; such an association of the wonders of nature and of art; such perfection of grand and beautiful perspective, as no expression of perceptible properties can convey to the minds of those who have not beheld the objects themselves. Being well aware of the transitory nature of impressions made upon the memory by sights of this kind, the author wrote a description of this scene while it was actually before his eyes; but how poor is the effect produced by detailing the parts of a view in a narrative, which ought to strike as a whole upon the sense! He may tell indeed of the dark-blue sea

streaked with hues of deepest purple—of imbrowning shadows—of lights effulgent as the sun—of marble pillars beaming a radiant brightness upon lofty precipices, whose sides are diversified by refreshing verdure, and by hoary mosses, and by gloomy and naked rocks; or by brighter surfaces reflecting the most vivid and varied tints; orange, red, and gray: to these he may add an account of distant summits, more intensely azured than the clear and cloudless sky—of islands dimly seen through silvery mists upon the wide expanse of water, shining towards the horizon as it were "a sea of glass;"—and when he has exhausted his vocabulary of every colour and shape exhibited by the face of nature or by the works of art, although he may not have deviated from the truth in any part of his description, how little and how ineffectual will be the result of his undertaking!

Dr E. D. Clarke.

PROPERTIES OF FREE CALORIC—RADIATION—CONDUCTORS.

Heat, strictly speaking, is the name of a sensation produced in animated bodies; but custom has adapted it likewise to inanimate matter; and we say, *the heat of the sun*, or *the heat of an oven*, just as readily as the *heat* which these bodies are capable of exciting. It was with a view to avoid the confusion which arose from thus confounding the cause and effect, that modern chemists adopted the new word *caloric* to denote the principle which produces heat; and it is in this sense that the word is generally employed in modern books of science.

Caloric is supposed to be a fluid of inappreciable tenuity, which is distributed in various proportions among the particles of bodies; and it is called *free caloric* or *heat of temperature*, whatever be its degree, or whatever the source whence it is derived, provided it is perceptible by the senses, or affects the thermometer. Free caloric always tends to diffuse itself equally; in other words, when two bodies are of different temperatures, the warmer

gradually parts with its caloric to the colder, till they are both brought to the same temperature. Thus, when a thermometer is applied to a hot body it receives caloric, when to a cold one it communicates part of its own caloric, and this communication continues until the thermometer and the body arrive at the same temperature. Cold is not a positive quality, but merely the diminution of heat. When you lay your hand on a marble table you indeed feel it *positively* cold; but the cold you experience consists merely in the loss of caloric that your hand sustains whilst its temperature is being brought to an equilibrium with the marble. If you lay a piece of ice upon the table, you will find that the contrary effect will take place,—the ice will be melted by the heat which it abstracts from the marble. But not only do the hotter bodies emit rays of caloric to the colder; there seems to be a reciprocal radiation among bodies. All bodies whatever appear to be constantly radiating or emitting caloric; the hotter emit it to the colder, and the colder to the hotter; nor is it more extraordinary that a hot body should receive caloric from a cold one, than that a candle should send forth rays of light to the sun, which yet must necessarily happen. Bodies that are of the same temperature give out and absorb equal quantities, so that no variation of temperature is produced in them; but when one body contains more caloric than another, the exchange is always in favour of the colder body, until an equal diffusion is effected: this is the case when the marble table cools your hand, and when it melts the ice.

Different bodies (or rather surfaces) possess the power of radiating caloric in very different degrees. From a series of ingenious experiments made by Sir John Leslie on this subject, it appears that black surfaces radiate most, white next, and polished surfaces the least of all. Hence it is that light-coloured clothes, in cold weather, keep us warmer than black ones; hence also a metallic vessel preserves the heat of the liquid within better than one of any other materials; silver teapots, for instance, make better tea than those of earthenware; and hence

steam-pipes, intended to convey heat to a distant apartment, are made bright in their course, but darkened at their destination. The property that different surfaces possess of radiating in different degrees may appear to be at variance with the doctrine respecting the equilibrium of caloric, inasmuch as it would seem to imply that those bodies which radiate most must ultimately become coldest. But it is to be recollected that the power of absorbing caloric corresponds with and is proportionate to that of radiation; so that, in equal temperatures, bodies compensate for the loss they sustain in consequence of their greater radiation by their greater absorption.

In establishing an equilibrium of temperature, caloric is distributed among the surrounding objects, not only by radiation, or in consequence of an interchange established from a distance, but also by communication, or through the means of intermediate bodies. Caloric passes through bodies with different degrees of velocity. Some substances oppose very little impediment to its passage, while it is transmitted slowly by others. Daily experience teaches, that though we cannot leave one end of a rod of iron for some time in the fire, and then touch its free extremity, without danger of being burnt, yet this may be done with perfect safety with a rod of glass or of wood. The caloric will speedily traverse the iron bar, so that, at the distance of a foot from the fire, it is impossible to support its heat; while we may hold a piece of redhot glass two or three inches from its extremity, or keep a piece of burning charcoal in the hand, though the part in combustion is only a few lines removed from the skin. The observation of these and similar facts has led to a division of bodies into conductors and non-conductors of caloric. The former division, of course, includes those bodies which allow caloric to pass freely through their substance, such as metals; and the latter comprises those which do not give an easy passage to it, such as stones, glass, wood, and charcoal.

Various methods have been adopted for determining the relative conducting power of different substances.

The most convenient is that of Ingenhouz. He covered little rods of the same form, size, and length, but of different materials, with a layer of wax, plunged their extremities into heated oil, and noted to what distance the wax was melted on each during the same interval. The metals were found, by this method, to conduct caloric better than any other substances; and of the metals, silver is the best conductor; gold comes next; then tin and copper, which are nearly equal; then iron, platinum, and lead.

An ingenious plan was adopted by Count Rumford for ascertaining the relative conducting powers of the different materials employed for clothing. He enveloped a thermometer in a glass cylinder blown into a ball at its extremity, and filled the interstice with the substance to be examined. Having heated the apparatus to the same temperature in every instance by immersing it in boiling water, he transferred it into melting ice, and observed carefully the number of seconds which elapsed during the passage of the thermometer through 135 degrees. When there was air between the thermometer and cylinder, the cooling took place in 576 seconds; when the insterstice was filled with fine lint, it took place in 1032″; with cotton-wool in 1046″; with sheep's wool in 1118″; with raw silk in 1284″; with beaver's fur in 1296″; with eider down in 1305″; and with hare's fur in 1315″. The general practice of mankind is therefore fully justified by experiment. In winter we retain the animal heat as much as possible by covering the body with bad conductors, as silk or woollen stuffs; in summer we have recourse to cotton or linen articles with an opposite intention.

A variety of familiar phenomena arises from the difference of conducting powers; thus, if a piece of iron and of glass be heated to the same degree, the sensation they communicate to the hand is very different; the iron will give the sensation of burning, while the glass feels but moderately warm. The quantity of caloric, which in a given time may be brought to the surface of the heated

body, so as to pass into the skin, is much greater in the iron than in the glass, and therefore in the former case the sensations must be more acute. This proves that our sense of touch is a very fallacious test of heat and cold; and hence, when we apply the hand to various objects in our apartment, we are very apt to form wrong notions of their temperature. The carpet will feel nearly as warm as our body; our book will feel cold, the table cold, the marble chimney-piece colder, and the candlestick colder still; yet a thermometer applied to them will stand in all at exactly the same elevation. They are all colder than the hand; but those that carry away caloric most rapidly excite the strongest sensations of cold.

A DIRGE.

"Earth to earth, and dust to dust!"
Here the evil and the just,
Here the youthful and the old,
Here the fearful and the bold,
Here the matron and the maid,
In one silent bed are laid;
Here the vassal and the king
Side by side lie withering;
Here the sword and sceptre rust—
"Earth to earth, and dust to dust!"

Age on age shall roll along,
O'er this pale and mighty throng;
Those that wept them, those that weep,
All shall with these sleepers sleep,
Brothers, sisters of the worm,
Summer's sun, or winter's storm,
Song of peace, or battle's roar,
Ne'er shall break their slumbers more.
Death shall keep his sullen trust—
"Earth to earth, and dust to dust!"

But a day is coming fast,
Earth, thy mightiest and thy last,
It shall come in fear and wonder,
Heralded by trump and thunder;

It shall come in strife and toil,
It shall come in blood and spoil,
It shall come in empires' groans,
Burning temples, trampled thrones;
Then, Ambition, rue thy lust!—
"Earth to earth, and dust to dust!"

Then shall come the judgment-sign;
In the east the King shall shine;
Flashing from heaven's golden gate,
Thousands, thousands round his state,
Spirits with the crown and plume.
Tremble then, thou sullen tomb!
Heaven shall open on our sight,
Earth be turn'd to living light,
Kingdoms of the ransom'd just—
"Earth to earth, and dust to dust!"

Then shall, gorgeous as a gem,
Shine thy mount, Jerusalem;
Then shall in the desert rise
Fruits of more than paradise;
Earth by angel feet be trod,
One great garden of her God;
Till are dried the martyrs' tears
Through a glorious thousand years.
Now in hope of him we trust—
"Earth to earth, and dust to dust!" CROLY.

CLOTHING FROM ANIMALS.—FUR, WOOL, SILK, LEATHER.

IN the hide of an animal, the hair and skin are two entirely distinct things, and must be considered separately as materials for clothing. The hair of quadrupeds differs much in fineness. It is chiefly the smaller species which are provided with those soft, thick, glossy coverings that bear the name of *fur*, and they are found in the greatest perfection where they are most wanted, that is, in the coldest countries. They form indeed the riches of those dreary wastes which produce nothing else for human use. The animals most esteemed for their fur are of the weasel kind: the glutton, the marten, the

sable, and the ermine. Fur is used either growing to the skin, or separated from it. In its detached state, it is usually employed in making a stuff called *felt.* The scales of hair are so disposed, that they make no resistance to the finger drawn along the hair from the root to the point, but cause a roughness and resistance in a contrary direction. From this property, hairs, when beaten or pressed together, are disposed to twist round each other, and thus to cohere into a mass. It is in the manufacture of hats that felting is chiefly practised; and the fur used for this purpose is that of the beaver, the rabbit, and the hare.

Wool differs from common hair in being more soft and supple, and more disposed to curl. These properties it owes to a degree of unctuosity, or greasiness, which is with difficulty separated from it. The whole wool, as taken from the animal's body, is called a *fleece.* The first operation this undergoes is that of picking and sorting into the different kinds of wool of which it is composed. These are next cleansed from marks and stains, and freed from their offensive greasiness. The wool is then delivered to the wool-comber, who, by means of iron-spiked combs, draws out the fibres, smooths and straightens them, separates the refuse, and brings it into a state fit for the spinner. The spinner forms the wool into threads, which are more or less twisted, according to the manufacture for which they are designed; the more twisted forming *worsted*, the looser *yarn.*

The kinds of stuffs made wholly or partly of wool are extremely various; and Great Britain produces more of them, and in general of better quality, than any other country. A more perfect manufacture than our broad cloths, with respect to beauty and utility, cannot easily be conceived. The threads in it are so concealed by a fine nap or down raised on the surface, and curiously smoothed and glossed, that it looks more like a rich texture of nature's forming, than the work of the weaver. Wool, in common with other animal substances, takes a dye

better than any vegetable matters. Our cloths are therefore made of every hue that can be desired; but, in order to fit them for the dyer, they are first freed from all greasiness and foulness by the operation of *fulling*, in which the cloths are beaten by heavy mallets as they lie in water, with which a quantity of fuller's earth has been mixed. This earth unites with the greasy matter, and renders it soluble in water; so that, by continually supplying fresh streams while the beating is going on, all the foulness is at length carried off. The operation of fulling has the farther effect of thickening the cloth, and rendering it more firm and compact, by mixing the threads with each other, something in the manner of a felt. The cloths of inferior fineness are mostly called narrow cloths. Some of those used for greatcoats, by their substance and shagginess, resemble the original fleece, or rather the fur of a bear, and render unnecessary the use of furred garments. Indeed, with the single material of wool, art has been able much better to suit the different wants of man in his clothing, than can be done by all the productions of nature. What could be so comfortable for our beds as blankets? What so warm and at the same time so light, for pained and palsied limbs, as flannel? The several kinds of the worsted manufacture are excellent for that elasticity which makes them sit close to a part without impeding its motions. This quality is particularly observable in stockings made of worsted. Even the thinnest of the woollen fabrics possess a considerable degree of warmth, as appears in shawls. The real shawls are made of the fine wool of Tibet, in the eastern part of Asia; but they have been well imitated by the product of some of our English looms. A very different article made of wool, yet equally appropriated to luxury, is carpeting. Upon the whole, Dyer's praise of wool seems to have a just foundation:—

> "Still shall o'er all prevail the shepherd's stores,
> For numerous uses known: none yield such warmth,
> Such beauteous hues receive, so long endure:
> So pliant to the loom, so various,—none."

Men must have been far advanced in the observation of nature before they found out a material for clothing in the labours of a caterpillar. China appears to have been the first country to make use of the web spun by the *silkworm*. This creature, which, in its perfect state, is a kind of moth, is hatched from the egg, in the form of a caterpillar, and passes from that state successively to those of a chrysalis, and of a winged insect. While a caterpillar, it eats voraciously, its proper and favourite food being the leaves of the different species of mulberry. By this diet it is not only nourished, but is enabled to lay up, in receptacles within its body formed for the purpose, a kind of transparent glue, which has the property of hardening as soon as it comes into the air. When arrived at full maturity, it spins itself a web out of this gluey matter, within which it is to lie safe and concealed during its transformation into the helpless and motionless state of a chrysalis.

The silkworm's web is an oval ball, called a cocoon, of a hue varying from light straw colour to full yellow, and consisting of a single thread wound round and round, so as to make a close and impenetrable covering. The thread is so very fine, that, when unravelled, it has been measured to 700 or 1000 feet, all rolled within the compass of a pigeon's egg. In a state of nature, the silkworm makes its cocoon upon the mulberry-tree itself, where it shines like a golden fruit among the leaves; and in the southern parts of China, and other warm countries of the East, it is still suffered to do so, the cocoons being gathered from the trees without farther trouble. But, in even the warmest climates of Europe, the inclemencies of the weather in spring, when the worms are hatched, will not permit the rearing them in the open air. They are kept, therefore, in warm but airy rooms, constructed for the purpose; and are regularly fed with mulberry-leaves till the period of their full growth. As this tree is one of the latest in leafing, silkworms cannot advantageously be reared in cold climates. During their growth, they several times shed their skins, and many

die under this operation. At length they become so full of the silky matter, that it gives them a yellowish tinge, and they cease to eat. Twigs are then presented to them upon little stages of wicker-work, on which they immediately begin to form their webs. When the cocoons are finished, a small number, reserved for breeding, are suffered to eat their way out in their butterfly state; the rest are killed in the chrysalis state, by exposing the cocoons to the heat of an oven.

The next business is to wind off the silk. After separating a downy matter from the outside of the cocoons, called *floss*, they are thrown into warm water; and the ends of the threads being found, several are joined together, and wound in a single one, upon a reel. This is the silk in its natural state, called *raw silk*. It next undergoes some operations to cleanse and render it more supple; after which it is made into what is called *organzine*, or *thrown silk*, being twisted into thread of such different degrees of fineness as are wanted in the different manufactures. This is done in the large way by mills of curious construction, which turn at once a vast number of spindles, and perform at the same time the processes of unwinding, twisting, reeling, &c. The largest and most complicated machine for this purpose, in England, is at Derby, the model of which was clandestinely brought from Italy, where all the branches of the silk manufacture have long flourished.

The excellence of silk, as a material for clothing, consists in its strength, lightness, lustre, and readiness in taking dyes. When little known in Europe, it was highly prized for its rarity; it is now esteemed for its real beauty and other valuable qualities. As it can never be produced in great abundance, it must always be a dear article of clothing. The fabrics of silk are very numerous, and almost all devoted to the purposes of show and luxury. In thickness they vary from the finest gauze to velvet, the pile of which renders it as close and warm as a fur. Some of the most beautiful of the silk manufactures are the glossy satin; the elegant damask, of which

the flowers are of the same hue with the piece, and only show themselves from the difference of shade; the rich brocade, in which flowers of natural colours, or of gold and silver thread, are interwoven; and the infinitely varied ribands. It is also a common material for stockings, gloves, buttons, strings, &c., in which its durability almost compensates for its dearness. Much is used for the purpose of sewing, no other thread approaching it in strength. Silk, in short, bears the same superiority among clothing materials that gold does among metals; it gives an appearance of richness wherever it is employed, and confers a real value. Even the refuse of silk is carefully collected, and serves for useful purposes. The down about the cocoons, and the waste separated in the operations raw silk undergoes, are spun into a coarser thread, of which very serviceable stockings are made; and the interior part of the cocoon is reckoned to be the best material for making artificial flowers.

Whilst the covering of the skins of animals thus affords a valuable material for clothing, the skin itself is not less useful. It requires, however, greater previous preparation. It is necessary to impregnate it with a matter capable of preserving it from putrefaction, and at the same time to keep it in a state of flexibility and suppleness. When this is effected, skin becomes *leather*,—a substance of the highest utility, as well in clothing as for numerous other purposes. The principal operation in the preparation of leather is called *tanning*.

The hide, taken off with due care by the skinner, is first thrown into a pit with water alone, in order to free it from dirt. After lying a day or two, it is placed upon a solid half-cylinder of stone, called a *beam*, where it is cleared of any adhering fat or flesh. It is then put into a pit containing a mixture of lime and water, in which it is kept about a fortnight. The intent of this is to swell and thicken the hide, and to loosen the hair. Being now replaced upon the beam, the hair is scraped off, and it is next committed to the *mastering-pit*. The contents

of this are some animal dung (pigeons' is preferred) and water; and its operation is to reduce that thickening which the lime had given. After this is effected, it is again cleansed on the beam, and is then put into the proper tanning liquor, called the *ooze*, which is an infusion of coarsely powdered oak-bark in water. The bark of the oak, as well as every other part of it, abounds in a strongly astringent matter; and it is the thorough impregnation with this which preserves the hide from decay or putrefaction. When at length it is thought to have imbibed enough of the astringent matter, the hide is taken out and hung upon a pole to drain, after which it is put upon a piece of wood with a convex surface, called a *horse*, on which it is stretched and kept smooth and even. Finally, it is taken to the *drying-house*, a covered building with apertures for the free admission of air; and it is there hung up till it becomes completely dry; and thus the process of tanning is finished.

From the tanner the hide or skin is consigned to the *currier*, whose art is farther necessary in order to make it perfect leather. He first soaks it thoroughly in water, and then places it upon a *beam*, made of hard wood, with one side sloping and polished. He lays it with the grain-side, or that on which the hair grew, inwards, and the flesh-side outwards. He then, with a broad two-edged knife, having a handle at each end, shaves or pares the hide on the latter side, till all its inequalities are removed, and it is reduced to the degree of thinness required for use. After this operation it is again put into water, then scoured and rubbed with a polished stone. It is next besmeared with a kind of oil procured from sheep or deer skin, or made by boiling train-oil and tallow together, with a view to soften or supple it. A great part of its moisture is then evaporated by hanging it up in a drying-house for some days; and it is farther dried by exposure to the sun, or to the heat of a stove. It is then differently treated, according as it is meant to be blacked or stained, or not. Without entering into minute particulars, it is enough to observe, that the astringent prin-

ciple with which the leather has been impregnated in the tanning, renders nothing necessary except the application of a solution of vitriol of iron, at once to strike a good black. This is laid on with a brush, generally on the grain side of the leather; and it afterwards undergoes the operation of giving it that roughness which is called the *grain*. This is performed by rubbing it in all directions with a fluted board. When leather is blackened on the flesh-side, the colour is given by a mixture of lamp-black and oil.

It is in the manner above described that leather is prepared for the making of shoes and boots, which is one of the principal uses of this material; and certainly no other substance could so well unite strength and suppleness with the property of keeping out water. The hides principally used in the shoe-manufacture are those of neat-cattle, or the ox-kind. For the more delicate work, the skins of the goat, dog, seal, and some other animals, are employed.

There is another mode of preparing leather, quite different from the preceding, which is called *tawing*. It is chiefly practised upon kid-skins, for the manufacture of fine gloves. The skin is first washed, and then soaked in lime-water, in order to get rid of the hair and grease. It is then softened in warm water and bran, and stretched out to dry, which renders it transparent. The preservative liquor is next applied, which is here not a vegetable astringent, but a solution of alum and common salt. With this it is impregnated so as to admit of keeping in that state several months. The next operation is to wash out the superfluous salts with warm water, which must be done with great nicety. Afterwards it is moderately dried, and then thrown into a tub in which yolks of eggs have been well mixed by beating. The skins are trodden in this, till all the egg is incorporated in their substance, which is thereby rendered more solid, and at the same time soft and pliable. Blood is sometimes, for cheapness, used instead of eggs; but it communicates a colour which cannot be entirely discharged. The skins

are then dried again, when they become fit either for taking a dye, or for being glossed, if preserved white. The method for preparing goat-skins for the celebrated Morocco leather resembles this; but the thickening matter in which the skins are trod is a bath of white figs with water. Dr AIKIN.

SECTION III.

VERSES WRITTEN IN THE CHURCHYARD OF RICHMOND.

METHINKS it is good to be here:
If thou wilt, let us build—but for whom?
Nor Elias nor Moses appear,
But the shadows of eve that encompass the gloom,
The abode of the dead and the place of the tomb.

Shall we build to Ambition? Ah! no:
Affrighted he shrinketh away;
For see! they would pin him below
To a small narrow cave, and begirt with cold clay,
To the meanest of reptiles a peer and a prey.

To Beauty? Ah! no: she forgets
The charms that she wielded before;
Nor knows the foul worm that he frets
The skin which, but yesterday, fools could adore
For the smoothness it held, or the tint which it wore.

Shall we build to the purple of Pride,
The trappings which dizen the proud?
Alas! they are all laid aside,
And here's neither dress nor adornment allow'd,
But the long winding-sheet and the fringe of the shroud.

To Riches? Alas! 'tis in vain:
Who hid, in their turns have been hid;
The treasures are squander'd again;

And here in the grave are all metals forbid,
But the tinsel that shone on the dark coffin-lid.

To the pleasures which Mirth can afford,
The revel, the laugh, and the jeer?
Ah! here is a plentiful board,
But the guests are all mute as their pitiful cheer,
And none but the worm is a reveller here.

Shall we build to Affection and Love?
Ah! no; they have wither'd and died,
Or fled with the spirit above,—
Friends, brothers, and sisters, are laid side by side,
Yet none have saluted, and none have replied.

Unto Sorrow? The dead cannot grieve,—
Not a sob, not a sigh meets mine ear
Which compassion itself could relieve;
Ah! sweetly they slumber, nor hope, love, or fear;
Peace, peace, is the watchword, the only one here.

Unto Death, to whom monarchs must bow?
Ah! no; for his empire is known,
And here there are trophies enow;
Beneath the cold dead, and around the dark stone,
Are the signs of a sceptre that none may disown.

The first tabernacle to Hope we will build,
And look for the sleepers around us to rise;
The second to Faith, which ensures it fulfill'd;
And the third to the Lamb of the great sacrifice,
Who bequeath'd us them both when he rose to the skies.

HERBERT KNOWLES.

CHEMICAL ATTRACTION.

Mrs B. Emily. Caroline.

E. Is there not another attraction in bodies besides cohesion and gravity, Mrs B.?

Mrs B. There is; the various bodies in nature, you must observe, are composed of certain elementary principles.

C. Yes; I know that all bodies are composed of fire, air, earth, and water; that I learnt many years ago.

Mrs B. But you must now endeavour to forget it. It is now proved, that neither fire, air, earth, nor water, can be called elementary bodies; for an elementary body is one that has never been decomposed, that is to say, separated into other substances; and fire, air, earth, and water, are all of them susceptible of decomposition.

E. I thought that decomposing a body was dividing it into its minutest parts; and, if so, I do not understand why an elementary substance is not capable of being decomposed as well as any other.

Mrs B. You have misconceived the idea of *decomposition;* it is very different from mere *division.* The latter simply reduces a body into parts, but the former separates it into the several ingredients or materials of which it is composed. If we were to take a loaf of bread, and separate the several ingredients of which it is made,—the flour, the yeast, the salt, and the water,—it would be very different from cutting or crumbling the loaf into pieces.

E. I understand you now very well.

C. But flour, water, and other materials of bread, according to your definition, are not elementary substances.

Mrs B. No, my dear; I mentioned bread rather as a familiar comparison to illustrate the idea, than as an example. The elementary substances of which a body is composed are called the *constituent* parts of that body; in decomposing it, therefore, we separate its constituent parts. If, on the contrary, we divide a body by chopping it to pieces, or even by grinding or pounding it to the finest powder, each of these small particles will still consist of a portion of the several constituent parts of the whole body: these are called the *integrant* parts: do you understand the difference?

E. Yes, I think, perfectly. We *decompose* a body into its *constituent* parts, and *divide* it into its *integrant* parts.

Mrs B. Exactly so. If, therefore, a body consists of only one kind of substance, though it may be divided

into its integrant parts, it is not possible to decompose it. Such bodies are therefore called *simple* or *elementary*, as they are the elements of which all other bodies are composed. *Compound bodies* are such as consist of more than one of these elementary principles. Now, chemical attraction consists in the peculiar tendency which bodies of a different nature have to unite with each other. It is by this force that all compositions and decompositions are effected.

E. What is the difference between chemical attraction and the attraction of cohesion.

Mrs B. The attraction of cohesion exists only between particles of the *same* nature, whether simple or compound; thus it unites the particles of a piece of metal, which is a simple substance, and likewise the particles of a loaf of bread, which is a compound. The attraction of composition, on the contrary, unites, and maintains in a state of combination, particles of a *dissimilar* nature: it is this power that forms each of the compound particles of which bread consists; and it is by the attraction of cohesion that all these particles are connected into a single mass. And observe also, that the attraction of cohesion unites particles of a similar nature, without changing their original properties; the result of such a union, therefore, is a body of the same kind as the particles of which it is formed; whilst the attraction of composition, by combining particles of a dissimilar nature, produces compound bodies quite different from any of their constituents. If, for instance, I pour on the piece of copper contained in this glass some of this liquid (nitric acid), for which it has a strong attraction, every particle of the copper will combine with a particle of acid, and together they will form a new body, totally different from either the copper or the acid. Do you observe the internal commotion that already begins to take place? It is produced by the combination of these two substances; and yet the acid has in this case to overcome, not only the resistance which the strong cohesion of the particles of copper opposes to their combination with it, but also

the weight of the copper, which makes it sink to the bottom of the glass, and prevents the acid from having such free access to it as it would if the metal were suspended in the liquid.

E. The acid seems, however, to overcome both these obstacles without difficulty, and appears to be very rapidly dissolving the copper.

Mrs B. And you may already see how totally different this compound is from either of its ingredients. It is neither colourless, like the acid, nor hard, heavy, and yellow, like the copper. If you tasted it you would no longer perceive the sourness of the acid. It has at present the appearance of a blue liquid; but when the union is completed, and the water with which the acid is diluted evaporated, the compound will assume the form of regular crystals of a fine blue colour, and perfectly transparent. Of these I can show you a specimen, as I have prepared some for that purpose.

C. How very beautiful they are in colour, form, and transparency! Nothing can be more striking than this example of chemical attraction.

Mrs B. The term *attraction* has been lately introduced as a substitute for the word *affinity;* but I confess that I think the word *attraction* best suited to the general law that unites the integrant particles of bodies; and *affinity* better adapted to that which combines the constituent particles, as it may convey an idea of the preference which some bodies have for others, which the term *attraction* does not so well express.

E. I do not conceive how bodies can be decomposed by chemical attraction. That this power should be the means of composing them is very obvious; but that it should, at the same time, produce exactly the contrary effect, appears to me rather paradoxical.

Mrs B. Let us call two ingredients, of which the body is composed, A and B. If we present to it another ingredient, C, which has a greater affinity for B than that which unites A and B, it necessarily follows that B will quit A to combine with C. The new ingredient, there-

fore, has effected a decomposition of the original body, A B; A has been left alone, and a new compound, B C, has been formed.

E. We might, I think, use the comparison of two friends, who were very happy in each other's society till a third disunited them by the preference which one of them gave to the new comer.

Mrs B. Very well. Let us suppose that we wish to decompose the compound we have just formed by the combination of the two ingredients, copper and nitric acid. We may do this by presenting to it a piece of iron, for which the acid has a stronger attraction than for copper; the acid will consequently quit the copper to combine with the iron, and the copper will be *precipitated*, that is to say, it will be thrown down in its separate state, and reappear in its simple form. In order to produce this effect, I shall dip the blade of this knife into the fluid; and, when I take it out, you will observe, that, instead of being wetted with a bluish liquid, like that contained in the glass, it will be covered with a thin coat of copper.

C. So it is really! But then is it not the copper, instead of the acid, that has combined with the iron blade?

Mrs B. No; you are deceived by appearances: it is the acid which combines with the iron, and, in so doing, deposits or precipitates the copper on the surface of the blade.

C. And pray, Mrs B., what is the cause of the chemical attraction of bodies for each other? It appears to me more extraordinary, or unnatural, if I may use the expression, than the attraction of cohesion, which unites particles of a similar nature.

Mrs B. It has not yet been satisfactorily explained. Perhaps, like that of cohesion or gravitation, it may merely be one of the powers inherent in matter, which, in the present state of our knowledge, admits of no other explanation than an immediate reference to a Divine cause.

Mrs Marcet.

ANCIENT SONG OF VICTORY.

Io! they come, they come!
  Garlands for every shrine;
Strike lyres to greet them home;
  Bring roses, pour ye wine.

Swell, swell the Dorian flute,
  Through the blue triumphal sky!
Let the cithern's tone salute
  The sons of victory!

With the offering of bright blood,
  They have ransom'd hearth and tomb,
Vineyard, and field, and flood;—
  Io! they come, they come!

Sing it where olives wave,
  And by the glittering sea,
And o'er each hero's grave,—
  Sing, sing the land is free!

Mark ye the flashing oars
  And the spears that light the deep,
How the festal sunshine pours
  Where the lords of battle sweep!

Each hath brought back his shield;—
  Maid, greet thy lover home!
Mother, from that proud field,
  Io! thy son is come!

Who murmur'd of the dead?
  Hush, boding voice! we know
That many a shining head
  Lies in its glory low.

Breathe not those names to-day!
  They shall have their praise erelong,
And a power all hearts to sway,
  In ever-burning song.

But now shed flowers, pour wine,
  To hail the conquerors home!
Bring wreaths for every shrine—
  Io! they come, they come!

Mrs HEMANS.

THE FIGURES OF SPEECH.*

The term *figure* signifies the shape or form of any piece of matter, and it has various secondary meanings, all reducible to this original idea. *Men of figure* are persons whom rank in life, or political influence, distinguishes from the bulk of mankind; and it may be said of men of eminent learning, or of the authors of useful discoveries and inventions in arts and sciences, that they will make a *figure* in the history of their country. Precisely on the same principles has this term been appropriated in its application to language. Certain forms of speech have been called figures, as distinguished from the usual way of expressing the same thought, and as eminently effective of eloquence.

Figurative language is opposed to *ordinary*, *plain*, or *literal* speech; and a figure of language may be defined to be a distinguished mode of speech which results from a peculiar state of mind suited to itself, and expresses a thought, mostly with some additional idea, and always more to the purpose of a writer or speaker than ordinary language. Thus, when we say of vicious indulgence, "that the enjoyment of it is often short, the recollection of it bitter and long continued," we express a common idea in common language. When we use the lines—

> "Pleasure, known but by its wings,
> And remember'd by its stings,"

we convey the same idea in the language of figure. It is essential to figurative language that it results naturally from a peculiar state of mind. Figures are the language of nature, not an invention of art; and however bold, or even apparently absurd, they originate in the principles of our constitution. In the use of them, the vulgar are often more correct than the learned; the former speaking as nature prompts, the latter attempting to forge

* The substance of this lesson is taken from an ingenious Essay on the Figures of Speech, by the Rev. Alex. Carson of Dublin.

them by study, from an affectation of ornament. Some have ventured to call figurative language the language of barbarians, in opposition to that of cultivated life; but such writers have yet to study the subject. It is indeed the language of barbarians, but it is also the language of civilisation. It is the language of the child, but it is also the language of the philosopher. *It is the language of human nature;* and the moment a man will make conscience of speaking the language of figure he will cease to speak the language of men.

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1. The figures which are founded on resemblance, are the metaphor, the comparison or simile, and the allegory.

The *metaphor*, the most common of all the figures, substitutes one thing for another, and applies to the primary object language which is, strictly speaking, descriptive only of the secondary. Thus, in Wolsey's description of the state of man, "To-day he puts forth the tender leaves of hope, to-morrow blossoms," a tree is put for man, and the changes, which can in strictness be predicated only of the secondary, tree, are attributed to the primary, man.—*Comparison*, or *simile*, is founded on resemblance as well as metaphor, but it has nothing else in common with it; and though it has been sometimes called a lengthened metaphor, it is altogether a distinct figure. Metaphor always asserts what is manifestly false; comparison asserts nothing but what is true. In metaphor the resembling qualities in the two objects must be distinguishing qualities of these objects. In comparison, any striking resemblance may be made the subject of the figure. The former asserts that one object has the properties of another; the latter, that one object resembles another. The two figures are indeed near akin, but they have a distinct personality; they are sisters, the daughters of Likeness by different fathers. The one is the child of Fancy, the other of Truth.—*Allegory* is generally considered, but incorrectly, as a continuation of metaphor. No continuation of metaphor ever becomes an allegory; indeed there are several essential properties that distin-

guish these figures. Allegory presents to immediate view the secondary object only; metaphor always presents the primary also. Metaphor always imagines one thing to be another; allegory never. Everything asserted in the allegory is applied to the secondary object; everything asserted in the metaphor is applied to the principal. In the metaphor there is but one meaning; in the allegory there are two, a literal and a figurative. Allegory is a veil; metaphor a perspective-glass. The following example, from the 80th Psalm, is one of the finest allegories:—

"Thou hast brought a vine out of Egypt; thou hast cast out the heathen, and planted it. Thou preparedst room before it, and didst cause it to take deep root, and it filled the land. The hills were covered with the shadow of it, and the boughs thereof were like the goodly cedars. She sent out her boughs unto the sea, and her branches unto the river. Why hast thou then broken down her hedges, so that all they which pass by the way do pluck her? The boar out of the wood doth waste it, and the wild beast of the field doth devour it. Return, we beseech thee, O God of hosts: look down from heaven, and behold, and visit this vine."

Allegory is a figure much seldomer employed than either metaphor or simile. The two last are frequently used by us, not only without any previous study, but even without any sensible exertion of the imagination; but to form an allegory the mind must look out for a likeness that will correspond in a variety of circumstances, and form an independent whole. The best occasion for the proper allegory is, when it is of importance to gain a man's own judgment against himself, without exciting his suspicions of our intention. We all know the effect of the parable spoken to David by Nathan; and we cannot fail to observe that no other form of speech could have here supplied the place of allegory. Many of the parables of Christ are of the same description; and the Scribes and Pharisees were often obliged to give judgment against themselves.

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2. *Irony*, *Hyperbole*, and *Interrogation*, may be considered as belonging to one class, as in all of them there is

an apparent inconsistency between the literal and the figurative meaning.—*Irony* employs words in a sense contrary to their literal meaning. Contempt employs it as one of its peculiar weapons; it is used also in upbraiding when there is no design to reprove. *You are an honest man!* And there is one very biting species of this figure, by which a person confesses himself guilty of that of which another is guilty, whom he wishes to expose. Sometimes also the strongest manner of denying a thing is by confessing it with an indignant ironical air; and there is often no better way of getting rid of an unreasonable arguer than by ironically agreeing with him. *Hyperbole* consists in describing a thing as greater or less than it is in reality; but, however wild, it does not mean to deceive us. It is extravagant only in words, and it never expects to be understood to the full amount of its statement. The following lines have been quoted as an example of hyperbole; but they furnish a specimen of impious raving rather than of figurative language:—

> "I found her on the floor,
> In all the storm of grief, yet beautiful:
> Pouring forth tears at such a lavish rate,
> That were the world on fire, they might have drown'd
> The wrath of Heaven, and quench'd the mighty ruin!"

We have a fine instance of this figure in the assertion of the Evangelist, when he tells us, that if all the works of Jesus had been recorded, the whole world would not have held the books; and also in the promise of God to Abram (Gen. xiii. 16), "I will make thy seed as the dust of the earth."—*Interrogation* implies *literally* ignorance or doubt; *figuratively*, the strongest confidence of conviction. In addition to the vehemence, earnestness, and fire, communicated to the style by this mode of speech, it derives a force of conviction from the real candour and intrepidity of truth which it evinces. It shows the perfect conviction of the speaker himself, and a fearlessness of examination. It is the clearest form in which an argument can be presented to the mind, and therefore

the best calculated to produce conviction. It brings an audience to a point, and obliges them to decide.

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3. *Antithesis* and *Climax* are figures of arrangement. *Antithesis* arranges the members of a section, so as, by contrast, to make objects more striking. The famous example from Cicero shows how it is calculated to strengthen the impression which an orator intends that an object should make :—" Is it credible that, when he declined putting Clodius to death with the consent of all, he should choose to do it with the disapprobation of many? Can you believe that the person whom he scrupled to slay,—when he might have done so with full justice, in a convenient place, at the proper time, with secure impunity,—he made no scruple to murder against justice, in an unfavourable place, at an unseasonable time, and at the risk of capital condemnation?"—*Climax* arranges its matter so that every succeeding object or circumstance rises above that which preceded. It has a grand effect where it has scope and is well managed; but it is proper only for things of importance. The noted example from Cicero against Verres is a fine one :—" It is highly criminal to bind a Roman citizen; to scourge him is enormous guilt; to kill him is almost parricide; but by what name shall I designate the crucifying of him?" A finer example never was uttered than that in the First Book of Samuel :—

" Now Eli was ninety and eight years old; and his eyes were dim that he could not see. And the man said unto Eli, I am he that came out of the army, and I fled to-day out of the army. And he said, What is there done, my son? And the messenger answered and said, Israel is fled before the Philistines, and there hath been also a great slaughter among the people, and thy two sons also, Hophni and Phinehas, are dead, and the ark of God is taken. And it came to pass, when he made mention of the ark of God, that he fell from off the seat backward by the side of the gate, and his neck brake, and he died; for he was an old man, and heavy: and he had judged Israel forty years."

The figure is correct, and the matter is in the highest degree affecting. *Israel is fled before the Philistines.*

Heavy news to a patriot in any country, but insupportably afflicting to an Israelite. How afflicting, then, to him who was at the head of the government, and whose neglect of parental duty was the cause of the defeat! *And there hath been also a great slaughter among the people!* It was no trifling loss, no momentary disgrace. It was not only defeat, but ruin. *And thy two sons also, Hophni and Phinehas, are dead!* The calamity still grows. He was an affectionate but a too indulgent father: his sons were profligate in the extreme. Their death, in such a situation, was a terrible blow to this man of God. But the worst is still to come. The glory of their nation, the token of the Divine presence among them, the ark of God, was in the hands of the uncircumcised: *And the ark of God is taken!*

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4. & 5. *Ellipsis* is prompted by great emotion, and expresses the thought in a hurried and incoherent manner. It passes with rapidity from one thing to another, without pointing out the connexion between them. The phraseology which it employs often appears incoherent and wild. Whatever strikes at the moment is uttered without order, and if before one thing is finished another occurs, the latter is immediately expressed. This figure is deficient in something essential to the grammatical construction. But many writers improperly ascribe to it every instance of grammatical abbreviation. Grammatical ellipsis is altogether different from the figurative. In conversation and familiar writing the former is to be found in almost every sentence, and is no indication of emotion. Its end is mere brevity. We have a fine example of this figure in the words of Isaac, on discovering that he was deceived in conferring the blessing,—"Who; where is he that hath taken venison, and brought it me?" &c.—*Pleonasm* is the opposite of ellipsis; the latter hurries over its objects, the former detains them as long as possible; and though at first sight it may appear strange that such opposite modes of speech should both be ornamental to style, they are alike founded in nature, and

alike available to the purposes of the poet and the orator. They cannot indeed both be beautiful in the same situation; but each has its proper place, which could not be supplied by the other. Pleonasm employs a redundancy of expression, not, however, without intention and effect. *I saw it with my eyes.* "Could you see it with your mouth?" replies the cynic. But nature and the most correct taste interpret such phraseology, and give important meaning to the apparent redundancy. Sometimes, after a general statement, various particulars are enumerated, to express the deep impression made on the mind of the speaker. Milton speaks thus with respect to his blindness:—

> "Nor to these idle orbs does day appear,
> Or sun, or moon, or stars, throughout the year,
> Or man, or woman."

After stating that he did not perceive the light of day, we needed not to be informed that he could not discern these other objects. But the person who should call this tautology would be as devoid of soul as an orang-outang. We can participate in the feelings of the poet, and brood with him over the objects of his regret. It soothes his melancholy to dwell on his bereavement, and it gives us a sad pleasure to accompany him. He cannot be dragged away from the pleasing objects which it is his misfortune for ever to be deprived of seeing. It is from a like principle that earnestness expresses its object again and again in nearly the same words: "Lord, hear my voice; let thine ear be attentive to the voice of my supplications." "Hear my prayer, O Lord, and let my cry come unto thee. Hide not thy face from me in the day of my trouble: incline thine ear unto me; in the day when I call, answer me speedily." There is nothing more affecting in language than David's lamentation for the death of his wicked son Absalom, which is just a combination of this figure and apostrophe. It is the very soul of sorrow:—"And the king was much moved, and went up to the chamber over the gate, and wept; and, as he went.

thus he said, O my son Absalom! my son, my son Absalom! would God I had died for thee, O Absalom, my son, my son!"

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6. *Personification* gives life and intelligence to inanimate objects; but it does not imply, as is sometimes asserted, any conviction, even the most momentary, of actual life and intelligence in the thing personified. We make the supposition, and enjoy all the advantages of the reality, though we are quite aware that we are figuring a thing to be what we know it is not. The chief intention of this figure appears to be a desire of giving vivacity to style, and, in the higher kinds of it, of giving vent to overpowering feeling. Some personifications are altogether the work of fancy, in which an attribute or quality is introduced as a person. Of this kind are those papers of Addison, Johnson, and many others, which have improperly been called allegories.

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7. *Apostrophe* addresses the absent or the dead, or, from the influence of passion, turns from the regular object of address to the person spoken of. Many fine examples of this figure are to be found in the Scriptures. David's lamentation about his son Absalom is one of the most affecting examples of an address to the dead. The Poems of Ossian are full of the most beautiful apostrophes. Cuthullin's address to his far-distant wife is the voice of nature:—

> "Strike the harp in praise of Bragela, whom I left in the isle of mist, the spouse of my love. Dost thou raise thy fair face from the rock to find the sails of Cuthullin? The sea is rolling far distant, and its white foam shall deceive thee for my sails. Retire, for it is night, my love, and the dark winds sigh in thy hair. Retire to the hall of my posts, and think of the times that are past; for I will not return till the storm of war is gone."

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8. *Exclamation* assumes the form of an address, but it expects no reply. It asks not to be informed, but to express the strong conception which it has of its object.

Interrogation and exclamation are often unskilfully confounded. The difference is this:—Interrogation, when a figure, always strongly asserts, and is used in argument; exclamation expresses agitated feeling, admiration, wonder, surprise, anger, joy, grief, &c., with respect to something that is not controverted:—"O the depth of the riches both of the wisdom and knowledge of God! How unsearchable are his judgments, and his ways past finding out!" Personification, apostrophe, exclamation, and metaphor, may all be combined:—"How art thou fallen from heaven, O Lucifer, son of the morning!"

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9. *Vision* represents a past or future action or event as happening before our eyes. Instead of narrative, vision gives the very words of another. A writer, commencing the account of an action or event in his own words, abruptly begins to repeat the words of the speaker of whom he is writing:—

> "Thus, at their shady lodge arrived, both stood,
> Both turn'd, and under open sky adored
> The God that made both sky, air, earth, and heaven,
> (Which they beheld), the moon's resplendent globe,
> And starry pole:—'Thou also madest the night,
> Maker Omnipotent, and thou the day.'"

Vision effects its purposes also by placing the speaker on the spot where the action or event happens, and by causing him to assume the direction of what takes place. He gives orders with uncontrolled authority, with respect to things over which he has not the smallest influence, and in which he is no more concerned than another. He addresses the spectators on every important occasion, and they can see nothing but as he directs their attention. The following picture of the passage of the English through the deep vale of the Till, and of the fatal inactivity of the Scottish army, is a fine instance of this figure:—

> "High sight it is, and haughty, while
> They dive into the deep defile;
> Beneath the cavern'd cliff they fall,
> Beneath the castle's airy wall.

By rock, by oak, by hawthorn tree,
Troop after troop are disappearing;
Troop after troop their banners rearing,
Upon the eastern bank you see.
Still pouring down the rocky den,
Where flows the sullen Till,
And rising from the dim-wood glen,
Standards on standards, men on men,
In slow succession still,
And, sweeping o'er the Gothic arch,
And pressing on, in ceaseless march,
To gain the opposing hill.

" And why stands Scotland idly now,
Dark Flodden! on thy airy brow,
Since England gains the pass the while,
And struggles through the deep defile?
What checks the fiery soul of James?
Why sits that champion of the dames
Inactive on his steed,
And sees, between him and his land,
Between him and Tweed's southern strand,
His host Lord Surrey lead?
What 'vails the vain knight-errant's brand?—
O, Douglas, for thy leading-wand!
Fierce Randolph, for thy speed!
O for one hour of Wallace wight,
Or well-skill'd Bruce, to rule the fight,
And cry,—'St Andrew and our right!'
Another sight had seen that morn,
From Fate's dark book a leaf been torn,
And Flodden had been Bannockburn!"

SIMPLE BODIES—OXYGEN, HYDROGEN, NITROGEN, CARBON, SULPHUR, PHOSPHORUS, THE METALS.

THE number of hitherto undecompounded bodies is about *sixty*. Four others—light, heat, electricity, and magnetism, called the *imponderable* bodies—have, by some, been added to these; but as their separate identity has not been clearly ascertained, they are not generally reckoned with the others. The whole of these sixty bodies may be *weighed* and *measured*, and hence (in contradistinction to the four bodies just mentioned, which cannot

be weighed and measured), are call *ponderable* bodies. These, in order to facilitate the acquirement of a knowledge of their properties, have been arranged as follows:

1. Bodies having an immense affinity for the simple bodies of the succeeding two classes; with which bodies they combine, and thereby form substances that are totally different in their properties from the substances of which they are composed:—

1. OXYGEN	3. IODINE	5. FLUORINE.
2. CHLORINE	4. BROMINE	

2. Bodies of a non-metallic nature, but inflammable or acidifiable:—

6. HYDROGEN 7. NITROGEN	*Gaseous Bodies.*
8. CARBON 9. BORON	*Fixed and Infusible Solids.*
10. SULPHUR 11. PHOSPHORUS	*Fusible and Volatile Solids.*

3. Inflammable or acidifiable substances of a metallic nature. This is the most numerous class of simple bodies; the individuals of which it is composed being in number *forty-nine.* These substances combine with nearly all the eleven bodies named above; but the most important compounds into which they enter are the bodies formed by their combination with oxygen.

Oxygen is one of the most important agents in nature. Scarcely a process of any description takes place in which it has not a share. In a simple state, it is obtained only in the form of *gas.* It is an exceedingly abundant body; the air of the atmosphere contains one-fifth, and water one-third of its bulk of it. It also exists in most natural products, animal, vegetable, and mineral. *Oxygen gas* is, like common air, colourless, invisible, tasteless, inodorous, and elastic. But it is heavier than common air, in the proportion of 111 to 100. It is a powerful supporter of combustion; that is to say, when any inflamed body, as a lighted taper, is put into

it, it burns very vigorously—much more so than if it were put into common air; indeed, it is owing to the oxygen it contains that common air supports combustion at all. Its presence is also essential for the continuance of animal life. We cannot breathe air which has been deprived of its oxygen; and it must be noticed, that an animal lives, and a combustible body burns, much longer in a definite quantity of oxygen gas, than it would in the same quantity of atmospherical air. Hence it is evident, that oxygen is the principle which supports both life and fire. Oxygen is not only found combined in natural bodies, but it can be made, by means of art, to combine with a great variety of substances, with which it forms very peculiar compounds.

Properly speaking, *oxygen gas is not a simple body;* since the gaseous state is not the natural state of oxygen, but is owing to the presence of a peculiar chemical agent which has already been described, called *caloric*. But as we know of no substances that are *separated* from caloric, it is customary to apply the term simple to such as are combined wich caloric only. *Gas* is the name given to all permanently elastic fluids, both simple and compound, except the atmosphere, to which the term *air* is appropriated. It is necessary to distinguish between *gas* and *vapour*. The latter is elastic and fluid, but not permanently so. The vapour of water (steam) upon cooling becomes a liquid: it is, therefore, not a *gas*, for *gases* are bodies whose aeriform state is permanent at natural temperatures.

Hydrogen is only known in the state of *gas*, and is sometimes called *inflammable* air. It is the lightest species of ponderable matter with which we are acquainted: compared to oxygen, its density is as 1 to 16. It is the basis of *water*, from which body it is chiefly procured. Hydrogen gas, when pure, is possessed of all the physical properties of common air; a slight odour, which it sometimes has, is produced by some substance that is held in solution by it. It does not support combustion, though it is itself one of the most combustible of all bodies;

being that which gives the power of burning with flame to all the substances used for the economical production of heat and light. But it only burns in the presence of oxygen.—It is not fit for respiration; for animals which breathe it die almost instantaneously. If pure oxygen and hydrogen gas be mixed together, they remain unaltered; but if a lighted taper be brought into contact with the mixture, it explodes with astonishing violence; and, if the two gaseous bodies have been mixed in certain proportions, the whole is condensed into water; hence we see the origin of the term *hydrogen*, which literally signifies *the water-former*. Hydrogen gas is the substance which, on account of its rarity, is employed to inflate air-balloons.

Nitrogen, called also *azote*, is a gaseous body, rather lighter than common air; of which it forms 4-5th parts in bulk, the remaining 1-5th being oxygen. It is tasteless, inodorous, colourless, and capable of being condensed and dilated. It extinguishes flame, and is fatal to animal life. It combines with oxygen in various proportions, forming compounds which differ greatly in their properties.

One of its most extraordinary compounds is *nitrous oxide*. This gas consists of 2 volumes of nitrogen and 1 volume of oxygen; and, when inhaled into the lungs, produces an extraordinary elevation of the animal spirits, a propensity to leaping and running, involuntary fits of laughter, &c. This circumstance shows what a variety of delightful or pernicious effects might flow from the slightest change in the constitution of the atmosphere, were the hand of the Almighty to interpose in altering the proportion of its constituent parts; for atmospheric air is composed of 4 volumes of nitrogen and 1 of oxygen, which is not a very different proportion from the above. Another gas, called *nitric oxide*, composed of 2 volumes of oxygen and 2 of nitrogen, produces instant suffocation in all animals that attempt to breathe it. One of the most corrosive acids, *aquafortis*, is composed of 5 of oxygen and

2 of nitrogen; so that we are every moment breathing certain substances, which, in another combination, would produce the most dreadful pain, and cause our immediate destruction.

Carbon is the name given to the pure inflammable part of *charcoal*, of which substance the diamond is only a variety in a pure crystallized state; for pure charcoal and diamond, when treated in the same manner, produce precisely the same results. Carbon is insoluble in water, and infusible by the most intense heat. Carbon combines with oxygen, and produces a gas called carbonic acid; and when combined with hydrogen gas, forms different kinds of carburetted hydrogen, which exist in the gas that is now used to light up shops. Animal and vegetable oils are composed almost entirely of carbon and hydrogen; the difference in their properties resulting chiefly from the variation in the proportions of these two bodies. The same may be observed of gum, sugar, and starch. All these bodies, however, contain oxygen.

Sulphur is a well-known substance, distinguished commonly by the name of brimstone. It is a hard, brittle body, of a yellow colour, destitute of smell, and of a weak taste. It is universally diffused in nature; but commonly combined with other bodies. It is insoluble in water; but, if poured into that liquid when liquefied by heat, it retains its softness, and in this state is employed for taking impressions from seals and medals. When exposed to heat in close vessels, it is sublimed or volatilized in the form of very fine powder, called *flowers of sulphur*. At a heat of about twice that of boiling water, it takes fire, if in contact with the air, and burns with a flame of a pale-blue colour. In this process it dissolves in the oxygen of the atmosphere, and produces an elastic fluid acid. It is a substance of great importance in chemistry and the arts. Oxygen unites with it in four proportions, its compounds forming an interesting series of acids. The

compounds of sulphur with metals are called sulphurets. With hydrogen it forms sulphuretted hydrogen gas.

Phosphorus is a semi-transparent yellowish matter, of the consistence of wax. It is procured, in general, by the decomposition of bones. It is so inflammable that it is set on fire at the temperature of about 150. Indeed, it has a luminous appearance, arising from a slow combustion, at the common temperature of the atmosphere. During its combustion, it emits a dense white smoke, which has the smell of garlic, and in the dark is luminous. On account of its very combustible nature, it requires to be handled with great caution. It is a violent poison.

The forty-nine *metals* compose the most numerous class of undecompounded chemical bodies, and are distinguished by the following general characters:—They possess a peculiar lustre.—They are opaque.—They are fusible by heat, and in fusion retain their lustre and opacity.—They are excellent conductors of electricity and heat.—Many of them may be extended under the hammer, and are called malleable; or under the rolling-press, and are called laminable; or drawn into wire, and are called ductile.—When exposed, highly heated, to the action of oxygen, chlorine, or iodine, they take fire, and are converted by the combustion into oxides, chlorides, or iodides,—bodies destitute of lustre and other metallic characteristics.—They will combine, in almost any proportion, with each other, when in a state of fusion, and thus form compounds, which are termed alloys, bodies that *retain* the properties of metals.—From their brilliancy and opacity, conjointly, they reflect the greater part of the light which falls on their surface; hence they form excellent mirrors.—They are very heavy; to this character, however (though it was till lately considered one of their most prominent features), there are important exceptions; since *metals* have been obtained (potassium and sodium, for instance) which are lighter than water. *Chemical Recreations.*

THE FIRST SABBATH.

Raphael to Adam.

HERE finish'd he, and all that he had made
View'd, and behold all was entirely good;
So even and morn accomplish'd the sixth day:
Yet not till the Creator from his work
Desisting, though unwearied, up return'd,
Up to the heaven of heavens, his high abode:
Thence to behold this new-created world,
The addition of his empire, how it show'd
In prospect from his throne, how good, how fair,
Answering his great idea. Up he rode,
Follow'd with acclamation, and the sound
Symphonious of ten thousand harps that tuned
Angelic harmonies: the earth, the air,
Resounded (thou rememberst, for thou heardst),
The heavens and all the constellations rung,
The planets in their station listening stood,
While the bright pomp ascended jubilant.
"Open, ye everlasting gates!" they sung,
"Open, ye heavens! your living doors; let in
The great Creator from his work return'd
Magnificent, his six days' work, a world;
Open, and henceforth oft; for God will deign
To visit oft the dwellings of just men,
Delighted; and with frequent intercourse
Thither will send his winged messengers
On errands of supernal grace."—So sung
The glorious train ascending; he through heaven,
That open'd wide her blazing portals, led
To God's eternal house direct the way;
A broad and ample road, whose dust is gold,
And pavement stars, as stars to thee appear
Seen in the galaxy, that milky-way
Which nightly, as a circling zone, thou seest
Powder'd with stars. And now on earth the seventh
Evening arose in Eden, for the sun
Was set, and twilight from the east came on,
Forerunning night; when at the holy mount
Of heaven's high-seated top, the imperial throne
Of Godhead fix'd for ever firm and sure,
The Filial Power arrived, and sat him down
With his great Father there; and, from his work

Now resting, bless'd and hallow'd the seventh day,
As resting on that day from all his work.
But not in silence holy kept: the harp
Had work and rested not; the solemn pipe,
And dulcimer, all organs of sweet stop,
All sounds on fret by string or golden wire,
Temper'd soft tunings, intermix'd with voice
Choral or unison; of incense clouds,
Fuming from golden censers, hid the mount.
Creation and the six days' acts they sung:
"Great are thy works, Jehovah! infinite
Thy power! what thought can measure thee, or tongue
Relate thee? Greater now in thy return
Than from the giant angels: thee that day
Thy thunders magnified; but to create
Is greater than created to destroy.
Who can impair thee, Mighty King, or bound
Thy empire? Easily the proud attempt
Of spirits apostate, and their counsels vain,
Thou hast repell'd; while impiously they thought
Thee to diminish, and from thee withdraw
The number of thy worshippers. Who seeks
To lessen thee, against his purpose serves
To manifest the more thy might: his evil
Thou usest, and from thence creatst more good.
Witness this new-made world, another heaven
From heaven-gate not far, founded in view
On the clear hyaline, the glassy sea;
Of amplitude almost immense, with stars
Numerous, and every star perhaps a world
Of destined habitation; but thou knowst
Their seasons: among these the seat of men,
Earth with her nether ocean circumfused,
Their pleasant dwelling-place. Thrice happy men,
And sons of men, whom God hath thus advanced!
Created in his image, there to dwell
And worship him; and in reward to rule
Over his works, on earth, in sea, or air,
And multiply a race of worshippers
Holy and just: thrice happy, if they know
Their happiness, and persevere upright!"
So sung they, and the empyrean rung
With halleluiahs: thus was the Sabbath kept. MILTON.

FIRST LINES OF MECHANICS.

Every body continues in its state of rest, or of uniform motion in a right line, unless compelled to change that state by force impressed upon it. All change of motion is proportioned to the force impressed, and is made in the direction of that force. Action and reaction are always equal and opposite; or the mutual actions of two bodies are always equal and in contrary directions:—These three general facts are denominated the laws of motion; they form the axioms in the science of mechanics; and all the facts and inferences which relate to the motion of bodies presuppose their truth, and are deducible from them.

When a body is simultaneously acted upon by two forces, the one of which would carry it in one direction. and the other in another, it will move in a line betwixt the two. Thus, if a piece of wood be thrown into a river, when the wind blows right across, it will be carried to the other side, but lower down. If the two forces are uniform, the body moves through the diagonal of a parallelogram; but if only one of the forces is uniform, and the other constantly accelerating or retarding, the body passes through a curve; thus, when a stone is thrown from the hand, the force impressed upon it tends to make it go on uniformly in the direction given to it; but, in consequence of the action of gravity, it is drawn more and more from the straight line in which it set off, till it is at last brought to the ground. The two forces here acting upon it make it describe a curve, which, but for the resistance of the atmosphere, would be a parabola. The planets are kept in their orbits by the action of two forces, the one drawing them to the sun, the other inclining them to fly off at a tangent; the consequence is (both forces being constant), that they revolve in orbits nearly circular.

The *Momentum* of a moving body is its weight combined with the velocity of its motion. Let us take a ball of lead and lay it on the ground, its weight will press on

it; but let us give it velocity also by throwing it on the ground, it will then have momentum, and make a mark. Sand is employed for shooting small birds, which it is intended to kill without injuring their plumage; sand blown by the wind would have no effect. Momentum may be increased by increasing either the velocity or the weight of a body; and its amount may always be estimated, by multiplying the weight and velocity together. It was on the principle that the momentum of a body is augmented by increasing its velocity, that, in ancient naval battles, the rowers strained with all their might at the onset; it is on the same principle that a ram, previous to striking, moves a little backward, and the same principle explains the battering-ram and many other warlike instruments of the ancients.

All bodies near our earth are drawn towards it, and in a direct line towards its centre, by the force of gravity. If from the top of a high tower or precipice, a stone be dropped, whatever number of feet it falls in the first second, it will fall three times as many in the second, five times as many in the third, seven times as many in the fourth, and so on. It falls, therefore, four times as much in two seconds as it does in one second, nine times as much in three, and sixteen times as much in four seconds. Therefore, to find how far a body falls in any given time, in other words, to find the height of the tower or precipice, multiply the space through which it falls in the first second by the square of the number of seconds. By experiment it is found, that a body falls 16 feet 1 inch in the first second; in two seconds, therefore, it will fall 64 feet 4 inches; in three seconds, 144 feet 9 inches, &c. A body rolling down an inclined plane, as the side of a hill, observes the same law—only the distance it rolls the first second depends upon the degree of inclination of the plane.

In retiring from the centre of the earth, gravity decreases as the square of the distance. Thus, a body 4000 miles from the surface of the earth, being twice as far from the centre as it would be at the surface, would

weigh only 1-4th of what it usually does; if 8000 miles from the surface, or three semi-diameters from the centre, it would weigh only 1-9th of what it usually does; if as far as the moon, or 60 semi-diameters, it would weigh only 1-3600th part. It is impossible to prove *directly*, that the weight of a body is thus diminished by distance from the centre of the earth, as that by which we would compare it must suffer an equal loss by the elevation; but the pendulum affords the means of proving it indirectly. The vibration of a pendulum depends entirely upon the attraction of the earth; the smaller, therefore, the attraction is, the less quickly will a pendulum vibrate, and the more slowly will a clock move. At the top of a high mountain, accordingly, a pendulum does not oscillate so fast as on the plain. At the equator, which is farther from the centre than places in the polar regions, a clock with a pendulum of the same length moves more slowly than with us. It was this fact, observed at Cayenne, which led Newton to suppose that the earth was not perfectly spherical, but flattened towards the poles; and actual measurement has verified his conjecture,—the polar diameter being found to be 26 miles less than the equatorial.

The *Centre of Gravity* is that point of a body, around which all its parts are so equally balanced, that, if *it* be supported, the whole body will be so too. Take a book, and find by trial under what part the finger must be placed to keep the book from falling; above that point is the centre of gravity. The centre of gravity always descends first. The cork of a shuttlecock always comes down before the feathers; and, for this reason, the point of an arrow is made heavier than the other end. A straight line, falling perpendicular to the ground from the centre of gravity, is called the *line of direction*. The broader the base upon which a body rests, the more difficult it will be to overturn it, as it must be moved the more to bring the line of direction beyond the base. A cask is easily rolled along; a box is moved with difficulty. When a man, in wrestling, is likely to be thrown down, he puts his feet as far asunder as possible.

The higher this centre of gravity, the more easily is a body overturned. A coach, empty inside, with passengers and luggage outside, is in more danger than if there be people inside. In man, the centre of gravity is so situated that the line of direction falls between his feet; the same in the case of quadrupeds. It is not easy for a dog to stand on his hind-legs, as the centre of gravity lies far forward. Ducks, geese, and swans walk awkwardly for the same reason. In cats, and animals that spring upon their prey, the centre of gravity is so situated, that they uniformly fall on their feet.—(*See Illustrations, Fig.* 7.)

MITCHELL.

GEOGRAPHICAL NOTICES.

1. *Land and Water.*—WHEN I cast my eyes over a map of the world, I perceive that it consists of one vast ocean, in which two large and many small islands are placed. There is, properly speaking, only one sea, which covers nearly three-fourths of the surface of the earth. All the gulfs and inland seas form only portions detached, but not entirely separated from that universal sea. Convenience, however, has recommended a division of this sea; and the following classification, though not that generally adopted, strikes me as the most simple and natural:—The *Austro-Oriental Basin*, including the South Sea, the Pacific Ocean, and the Indian Ocean, with their respective gulfs, inland seas, &c.; and the *Western Basin*, including the Northern Ocean, the Atlantic Ocean, and the Ethiopic Ocean, with their respective gulfs, &c.

The form of the Western Basin is very remarkable. It resembles a channel narrowing towards the poles, and it is flanked on both sides by projections of land and inland seas, that bear a close resemblance to each other. The situation of Britain and the adjoining coasts on the one side, closely resembles that of Newfoundland and the adjacent shore on the other; the peninsula of Spain resembles that of Florida; the coast of Upper Guinea that of Brazil; and the shores of Africa those of South

America. The Baltic and Northern Seas correspond to Baffin's and Hudson's Bays; the Mediterranean Sea to the Gulf of Mexico. With respect to the Austro-Oriental Basin, I have only one singular fact to mention,—it is surrounded, or nearly so, with a chain of mountains, steep towards the sea, and sloping towards the landward side. This chain commences with Table Mountain in the South of Africa, proceeds to Behring's Straits, and thence through America southward to Cape Horn. Many smaller chains radiate from this chain at different angles, and, in general, the land, as may be determined by the course of the rivers, gradually slopes from the summit of this great chain towards the shores of the Western Basin: in America, Africa, and Europe, at least, this is very obvious.

The two great continents present a remarkable similarity of appearance in one respect—the direction of their peninsulas; for, with the exception of two, Yucatan and Jutland, which consist only of plains of alluvial land, they are all turned towards the south. But the general direction of the land is entirely different in the two continents; in the new it extends from pole to pole; whilst in the old it is nearly parallel to the equator. The peculiarities of the isthmuses which divide each continent into two unequal parts,—Suez being composed of sand, and Panama of granite and pophyry,—lead us to remark another very singular difference in those two great islands of the globe. The ancient world is in almost every part open to the advances of the ocean; and from the Straits of Behring to those of Babelmandeb on the one side, and to those of Gibraltar on the other, the bays, gulfs, inland seas, &c., are in a sort of equilibrium, at least in respect to numbers; whilst the mass of Africa alone is not penetrated by a single gulf. The new continent, on the contrary, has only one considerable gulf, that of California, on its western shore; but presents, on its eastern, a continued chain of gulfs, inland seas, and magnificent rivers.

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2. *The Ocean.*—The chief properties of the ocean,

which it is the business of physical geography to investigate, are its depth, the quantity of water it contains, its motions, temperature, and saltness.

With respect to its *depth*, no certain conclusions have yet been formed. The Atlantic Ocean has been recently sounded with a line of $8\frac{3}{4}$ miles long, which reached the bottom. Along the coast its depth has generally been found proportioned to the height of the shore; where the coast is high and mountainous, the sea that washes it is deep; but where the coast is low, the water is shallow.—To calculate the *quantity of water* it contains we must therefore suppose a medium depth. If we reckon its average depth at two miles, it will contain 296 millions of cubical miles of water. We shall have a more specific idea of this enormous mass of water, if we consider that it is sufficient to cover the whole globe to the height of more than 8000 feet; and if this water were reduced to one spherical mass, it would form a globe of more than 800 miles in diameter.

The ocean has *three kinds of motions*. The first is that undulation which is produced by the wind, and which is entirely confined to its surface. It is now ascertained that this motion can be destroyed, and its surface rendered smooth, by throwing oil upon its waves. The second motion is that continual tendency which the whole water in the sea has towards the west, which is greater near the equator than towards the poles. It begins on the west side of America, where it is moderate; but as the waters advance westward their motion is accelerated; and, after having traversed the globe, they return, and strike with great violence on the *eastern* shore of America. Being stopped by that continent, they rush with impetuosity into the Gulf of Mexico, thence they proceed along the coast of North America, till they come to the south side of the great bank of Newfoundland, when they turn off and run down through the Western Isles. This motion is most probably owing to the diurnal revolution of the earth on its axis, which is in a direction contrary to the motion of the sea. The third motion of

the sea is the *tide*, which is a regular swell of the ocean every $12\frac{1}{2}$ hours. This motion is now ascertained to be owing to the attractive influence of the moon, and also partly to that of the sun. There is always a flux and reflux at the same time, in two parts of the globe, and these are opposite to each other, so that when our antipodes have high water we have the same. When the attractive powers of the sun and moon act in the *same* or in *opposite* directions, which happens at the time of *new* and *full moon*, we have the highest or *spring-tides;* but when the lines of their attraction are at right angles to each other, which happens at the *quarters*, we have the lowest or *neap-tides.*

As water is a worse conductor of heat than land, that is, absorbs and gives out heat more slowly, the *temperature* of the sea is subject to fewer and less extensive variations than the land. It is never so cold in winter, nor so hot in summer; for, when the surface of the water is cooled in winter, it becomes specifically heavier than the inferior stratum, and sinks; and when it is more heated in summer, it is carried off by evaporation, and in this way the uniformity of temperature is preserved.

The *saltness* of the sea is one of its most distinctive features. It contains a great quantity of saline substances, to which it owes its peculiar taste. Besides common salt, or muriate of soda, sea-water is impregnated with muriate of magnesia, sulphate of magnesia, and sulphate of lime. And the amount of the saline ingredients varies from $\frac{1}{24}$ to $\frac{1}{28}$; the proportion being greatest at a distance from the shore, and from the vicinity of large rivers, by which the waters of the ocean are diluted. It is easier to perceive the great advantages resulting from this saltness, than to discover its origin. Without this saltness, and without the agitation in which they are continually kept, the waters of the sea would become tainted, and would be infinitely less adapted for the motion of vessels; and probably it is to this also that the inhabitants of the ocean owe their existence. DICK.

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3. *Mountains.*—THE highest mountains in the world, according to the latest accounts, are the *Himalaya* chain,

north of Bengal, on the borders of Tibet. The highest mountain in this range is stated to be 28,177 feet, or about $5\frac{1}{3}$ miles in perpendicular height, and is visible at the distance of 230 miles. Next to the Himalayas are the Andes, in South America, which extend more than 4000 miles in length, from the province of Quito to the Straits of Magellan. The highest summit of the Andes is Aconcagua in Upper Peru, which is said to be 23,912 feet, or $4\frac{1}{2}$ miles above the level of the sea. The highest mountains in Europe are the Alps, which run through Switzerland and the north of Italy; the Pyrenees, which separate France from Spain; and the Dovréfeld, which divide Norway from Sweden. The most elevated ridges in Asia, besides the Himalaya, are Mount Taurus, Imaus, Caucasus, Ararat, the Uralian, the Altaian, and the Japanese mountains; in Africa, Mount Atlas, the Mountains of the Moon, and the mountains opposite Fernando Po. Some of the mountains in these ranges are found to contain immense caverns, or perforations of more than two miles in circumference, reaching from their summits to an immeasurable depth into the bowels of the earth. From these dreadful openings are frequently thrown up, to an immense height, torrents of fire and smoke, rivers of melted metals, clouds of ashes and cinders, and sometimes redhot stones and enormous rocks, to the distance of several miles, accompanied with thunders, lightnings, darkness, and horrid subterraneous sounds, producing the most terrible devastations through all the surrounding districts. The most noted mountains of this kind in Europe are Mount Hecla, in Iceland; Etna, in Sicily; and Vesuvius, near the city of Naples, in Italy. Two great volcanic ranges have been traced, the one extending from Chili to the north of Mexico, the other from the Peninsula of Alaska to the Aleutian, Japanese, Philippine, and East Indian Islands. Besides these extended lines there are several smaller groups and single burning mountains both in Asia and America, as well as in the African Islands; the whole number of active volcanoes being estimated at about 200.—(*See Illustrations*, *Fig.* 8.)

Mountains serve a variety of useful purposes. Their lofty summits are destined by Providence to arrest the

vapours which float in the regions of the air; their internal cavities form so many spacious basins for the reception of waters distilled from the clouds; they are the original source of springs and rivers, which water and fertilize the earth; they form immense magazines, in which are deposited stones, metals, and minerals, which are of so essential service in the arts that promote the comfort of human life; they serve for the production of a vast variety of herbs and trees; they arrest the progress of storms and tempests; they afford shelter and entertainment to various animals which minister to the wants of mankind: in a word, they adorn and embellish the face of nature; they form thousands of sublime and beautiful landscapes, and afford from their summits the most delightful prospects of the plains below. All these circumstances demonstrate the wisdom of the Great Architect of nature, and lead us to conclude, that mountains, so far from being rude excrescences, form an essential part in the constitution, not only of our globe, but of all habitable worlds. DICK.

THE COVENANTERS.

THEY stood prepared to die, a people doom'd
To death;—old men, and youths, and simple maids.
With them each day was holy; but that morn,
On which the angel said, *See where the Lord*
Was laid, joyous arose; to die that day
Was bliss. Long ere the dawn, by devious ways,
O'er hills, through woods, o'er dreary wastes, they sought
The upland moors, where rivers, there but brooks,
Dispart to different seas. Fast by such brooks
A little glen is sometimes scoop'd, a plat
With greensward gay, and flowers that strangers seem
Amid the heathery wild, that all around
Fatigues the eye: in solitudes like these
Thy persecuted children, SCOTIA, foil'd
A tyrant's and a bigot's bloody laws:
There, leaning on his spear (one of the array,
Whose gleam, in former days, had scathed the rose
On England's banner, and had powerless struck

The infatuate monarch and his wavering host),
The lyart veteran heard the word of God
By Cameron thunder'd, or by Renwick pour'd
In gentle stream: then rose the song, the loud
Acclaim of praise; the wheeling plover ceased
Her plaint; the solitary place was glad:
And on the distant cairns the watchers' ear*
Caught doubtfully at times the breeze-borne note.
But years more gloomy follow'd; and no more
The assembled people dared, in face of day,
To worship God, or even at the dead
Of night, save when the wintry storm raved fierce,
And thunder-peals compell'd the men of blood
To couch within their dens; then dauntlessly
The scatter'd few would meet, in some deep dell
By rocks o'ercanopied, to hear the voice,
Their faithful pastor's voice: he by the gleam
Of sheeted lightning oped the sacred book,
And words of comfort spake: over their souls
His accents soothing came,—as to her young
The heathfowl's plumes, when, at the close of eve,
She gathers in, mournful, her brood dispersed
By murderous sport, and o'er the remnant spreads
Fondly her wings; close nestling 'neath her breast,
They, cherish'd, cower amid the purple blooms.

GRAHAME.

SUFFERINGS OF THE EARLY CHRISTIANS.

SEVERAL happy years had passed away, during which the mind of Harry Beaufoy continued in a course of progressive improvement. His attention having been successfully directed to the observation of those proofs of Divine power and wisdom which are manifest in the works of creation, he did not relinquish a habit which proved the source of continually increasing pleasure to him. As the powers of Harry's mind gradually unfolded,

* Sentinels were placed on the surrounding hills to give warning of the approach of the military.

he became more of a companion to his mother. She was in the practice of devoting an hour every morning to hearing him read, and bestowed a great deal of pains in selecting subjects likely to conduce to his improvement. In consequence of enjoying this advantage, Harry Beaufoy, at the age of thirteen, was familiar with many of the finest passages of our poets and historians. His increasing knowledge of words was also made subservient to the improvement of his taste and understanding; and, as he was encouraged to ask questions and propose difficulties, the hour of reading often gave birth to some interesting conversation, calculated to impress his mind with the superior importance of moral and religious principle.

One evening, after reading an account of the sufferings of the Waldenses for their religious opinions, Harry led to a conversation of this kind, by asking his mother, whether any other people had undergone such cruel treatment as the Waldenses.

"Yes," replied she; "I have read of a people whose simplicity of character, zeal in propagating their religion, and constancy under suffering, very much resembled what we have heard of the inhabitants of the valleys." Taking up a Testament that was lying on the sofa, she continued,—"We shall find the best account of them *here*."

"Surely you cannot mean that the apostles resembled the Waldenses?"

"Let St Paul speak for himself," replied Mrs Beaufoy, turning to the 11th chapter of his Second Epistle to the Corinthians, from which she read the following passage:—"Of the Jews five times received I forty stripes save one. Thrice was I beaten with rods, once was I stoned, thrice I suffered shipwreck," &c. "Nor were such sufferings peculiar to St Paul; they were common to all the early Christians."

"But if the Christians did not break the laws, or give any just cause of offence, I cannot understand why they should be exposed to such general persecution."

"This was one of the wise appointments of Providence for which we have reason to be thankful."

"Oh! mamma, when innocent people were shamefully treated, surely this is a strange cause for thankfulness!"

"It does appear very strange, I confess; but are you not aware that it is of the utmost importance for us to be quite sure that our religion is *true?*"

"Certainly; I never thought of doubting the truth of it; but these shocking sufferings of good people for the sake of religion are very puzzling."

"We are apt to *doubt* of things that puzzle us," replied Mrs Beaufoy; "and, therefore, in an affair so important as religion, it is necessary for us to endeavour to understand the true reason of those appointments, which at first sight do not seem agreeable to the just government of Providence."

"And that," said Harry, "is the very thing I wish you to explain to me."

"Well, then, let me first ask you, whether it is likely that the Son of God would come down from heaven, and suffer upon earth for the salvation of men, without some very wonderful circumstances attending such a transaction."

"Certainly not; because the thing itself is so very astonishing. It appears more surprising the longer I think about it."

"And are we not naturally inclined to doubt an astonishing story, unless we have very good reason for believing it to be true? We might, however, be inclined to believe it, if we heard it from persons of good character, who declared that they witnessed the transaction; but if, in order to attest the truth of the story, it was necessary for these persons to expose themselves to a great deal of mortification and ill-treatment; and if, notwithstanding this, they were all to persist in giving the same account of what had happened, it seems to me impossible not to believe them."

"I think so too," said Harry; "if we can be quite sure that they were not mistaken."

"Undoubtedly that is a point which ought to be determined, before we give credit to any event out of the common course of nature; and it is our business to examine whether it was possible for the witnesses to be deceived. The first Christians united in asserting a most astonishing fact: they were poor, illiterate men, possessing neither talents nor influence to give them credit with their countrymen; but they were quite sure of what they had seen with their own eyes; and, rather than conceal or deny the truth, they willingly submitted to the greatest dangers and sufferings, not of a transient nature, but protracted through a long course of years; many of them even laying down their lives in support of this singular assertion."

"I thought, mamma, they were persecuted for being Christians, not for asserting any particular fact."

"But what was it that made them Christians? Was it not the facts which they witnessed? Was it not the resurrection of Jesus that convinced them he was the Messiah?"

"Then, it seems, that asserting that Christ was the Messiah brought persecution on his disciples?"

"Yes; and no wonder the Jews should be enraged at an assertion which reproached them with the guilt of despising and rejecting, and cruelly putting to death the Son of God. Besides, it shocked all their fondest hopes and prejudices. They had worked themselves into a persuasion, that the long-promised Deliverer would, on his arrival, effect some wonderful change in the condition of their country; they did not think of a deliverance from the power and guilt of sin—of freedom from the tyranny of evil passions—but from the dominion of the Romans. They clung to this hope under every misfortune of their country, and with greater eagerness as its calamities increased; they were buoyed up by it during the miseries of the most dreadful siege recorded in history. Josephus tells us, that, on the day when the city

was taken, a false prophet persuaded these infatuated people to ascend the battlements of the Temple, in expectation of there receiving miraculous signs of their deliverance."

"I see it plainly now, mamma. The apostles could have nothing but ill treatment to expect from all their countrymen who did not believe them."

"And do you believe it possible, that people would choose to undergo such sufferings in attestation of a falsehood by which they could gain no worldly advantage, while their hypocrisy would expose them to the Divine displeasure?"

"Why—no; I should think not," said Harry, rather doubtfully.

"You surprise me, my dear child. How can you suppose the possibility of such madness?"

"I was thinking just then of the Old Man of the Mountain, and that his followers would leap from the top of a tower at the slightest sign from their chief."*

"And did they expect *to gain nothing* by such implicit devotion to his will?"

"Oh, yes; they were taught from childhood to believe that it would procure them eternal happiness."

"Then was not leaping from the tower a proof that they were *sincere* in that belief?"

"Certainly, mamma."

"Very well, Harry; then your story, instead of weakening my argument, will confirm it. The belief of these Mahometan enthusiasts related to a matter of *opinion*, in which, from what we know of the Divine government, we conclude that they were mistaken; but the assertion of the apostles related to a matter of *fact*. We know to a *certainty* whether we see a person or do not see him; it is a case which admits of no mistake. When Christ appeared again, it was not once, to two or three individuals, but repeatedly, and to a great number. 'He was seen,' says St Paul, 'of Cephas, then of the twelve. After

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* English Stories, vol. i. p. 344.

that he was seen of above five hundred brethren at once, of whom the greater part remain unto the present.' If the story was false, would Paul have ventured to mention this host of *living witnesses*, who might so easily have come forward and contradicted the statement?"

A pause of some minutes followed, when Harry again asked his mother,—"But how came the Romans to be angry with the Christians? *They* could have no popular expectations to be disappointed; on the contrary, they must have been glad that the Messiah was not a conquering prince."

"You had better judge of the feelings of the Romans from their own account of the circumstances. Give me the fourth volume of Murphy's Tacitus out of the bookcase, and I will find the passage for you."

Harry then read to his mother the account of that dreadful fire, by which more than three quarters of the city were destroyed. Mrs Beaufoy turned over a few pages, and said,—"Read on from that place." Harry obeyed, and read as follows:—"But neither these religious ceremonies, nor the liberal donations of the prince, could efface from the minds of men the prevailing opinion, that Rome was set on fire by his own orders. In order, if possible, to remove the imputation, he determined to transfer the guilt to others. For this purpose he punished, with exquisite tortures, a race of men detested for their evil practices, by vulgar appellation commonly called Christians. The name was derived from Christ, who, in the reign of Tiberius, suffered under Pontius Pilate, the procurator of Judea. They were put to death with exquisite cruelty, and to their sufferings Nero added mockery and derision. Some were covered with the skins of wild beasts, and left to be devoured by dogs; others were nailed to the cross; numbers were burnt alive; and many, covered over with inflammable matter, were lighted up, when the day declined, to serve as torches during the night."

"What a horrible monster that Nero must have been!" said Harry, when he had finished reading; "but it seems

as if Tacitus, though he pitied the sufferings of the Christians, thought them a wicked people."

"He certainly entertained the popular prejudice against them. The Jews had been banished from Rome by the Emperor Claudius, who preceded Nero, on account of their raising seditious tumults: the Christians, being only an obscure sect among the Jews, were included in the number, and the rebellious and vindictive spirit of the latter was imputed to the former without discrimination."

"I do not like Tacitus at all!" exclaimed Harry; "it was shameful to misrepresent the conduct of a people who had already suffered so much."

"Yet the testimony of Tacitus is valuable, and not less so for coming from an enemy of the Christians. You see, it proves that our Saviour suffered under Pontius Pilate, and that there were, within thirty-one years after his crucifixion, great numbers of Christians, not only in Judea, but at Rome; and this agrees with the account we have in the Scriptures." MRS HACK.

HOME.

THERE is a land, of every land the pride,
Beloved by Heaven o'er all the world beside;
Where brighter suns dispense serener light,
And milder moons emparadise the night;
A land of beauty, virtue, valour, truth,
Time-tutor'd age, and love-exalted youth:
The wandering mariner, whose eye explores
The wealthiest isles, the most enchanting shores,
Views not a realm so bountiful and fair,
Nor breathes the spirit of a purer air;
In every clime the magnet of his soul,
Touch'd by remembrance, trembles to that pole
For in this land of Heaven's peculiar grace,
The heritage of nature's noblest race,
There is a spot of earth supremely blest,
A dearer, sweeter spot than all the rest,
Where man, creation's tyrant, casts aside
His sword and sceptre, pageantry and pride,

While in his soften'd looks benignly blend
The sire, the son, the husband, brother, friend;
Here woman reigns; the mother, daughter, wife,
Strew with fresh flowers the narrow way of life!
In the clear heaven of her delightful eye,
An angel-guard of loves and graces lie;
Around her knees domestic duties meet,
And fireside pleasures gambol at her feet.
Where shall that land, that spot of earth be found!
Art thou a man?—a patriot?—look around;
O, thou shalt find, howe'er thy footsteps roam,
That land *thy* country, and that spot *thy* Home.

O'er China's garden-fields, and peopled floods,
In California's pathless world of woods;
Round Andes' heights, where Winter from his throne
Looks down in scorn upon the summer zone;
By the gay borders of Bermuda's isles,
Where spring with everlasting verdure smiles;
On pure Madeira's vine-robed hills of health;
In Java's swamps of pestilence and wealth;
Where Babel stood, where wolves and jackals drink,
'Midst weeping willows on Euphrates' brink;
On Carmel's crest; by Jordan's reverend stream,
Where Canaan's glories vanish like a dream;
Where Greece, a spectre, haunts her heroes' graves,
And Rome's vast ruins darken Tiber's waves;
Where broken-hearted Switzerland bewails
Her subject mountains and dishonour'd vales;
Where Albion's rocks exult amidst the sea,
Around the beauteous isle of Liberty;
Man, through all ages of revolving time,
Unchanging man in every varying clime,
Deems his own land of every land the pride,
Beloved by Heaven o'er all the world beside;
His Home the spot of earth supremely blest,
A dearer, sweeter spot than all the rest.

MONTGOMERY.

SECTION IV.

VEGETABLE PHYSIOLOGY.

Plants, whether regarded as individuals, or as grouped in the garden, the field, and the landscape, are objects of universal interest. The beauty of their forms; the delicacy, harmony, and splendour of their colours; the fragrance which they exhale; the refreshing verdure and the convenient shade which we owe to them, besides their more important uses in contributing largely to our raiment, our sustenance, and our lodging;—these connect our interests, and even our existence, with theirs: whilst the examination of their conformation, and the observation of their functions, as organized living beings, expand and elevate the mind, and raise its contemplations in wonder and in gratitude to the great Source of all life.

While a plant differs from an animal in exhibiting no signs of perception or voluntary motion, and in possessing no stomach to serve as a receptacle for its food, there exists between them a close analogy both of parts and functions. The stem and branches act as a framework or skeleton for the support and protection of the parts necessary to the life of the individual. The root serves the purpose of a stomach by imbibing nutritious juices from the soil, and thus supplying the plant with materials for its growth. The sap or circulating fluid composed of water holding in solution saline, extractive, mucilaginous, saccharine, and other soluble substances, corresponds in its office to the blood of animals; and in its passage through the leaves, which may be termed the lungs of a plant, it is fully exposed to the agency of light and air, and experiences a change by which it is more completely adapted to the wants of the vegetable economy.

Motion of the Sap.—THE fluids destined to nourish a plant, being absorbed in the root, where they are converted into sap, are carried up into the leaves by what are called the *common* vessels,—a particular set of these, appropriated to each leaf, branching off, a few inches below the leaf to which they belong, from the main channels that pass along the alburnum. These vessels may be considered as analogous to the arteries of animals, or rather they are the stomach, lacteals, and arteries, all in one. They absorb the nutritious fluids afforded by the soil, in which, possibly, as they pass through the root, some change analogous to digestion takes place; for there is in general a great difference between the fluids of the root and those of the rest of the plant.

Part of the sap is conveyed into the flowers and fruit, but by far the greater portion is carried into the leaves. In these organs the sap is exposed to the action of light, air, and moisture, three powerful agents, by which it is enabled to form various secretions, at the same time that much superfluous matter passes off by perspiration. These secretions not only give peculiar flavours and qualities to the leaf itself, but are returned by another set of vessels into the new layer of bark, which they nourish and bring to perfection, and which they enable in its turn to secrete matter for a new layer of alburnum the ensuing year. It is presumed that one set of the returning vessels may be more particularly destined to this latter office, and another to the secretion of the peculiar fluids, as gum, resin, &c., which are known to be deposited and perfected in the bark.

A portion of the sap, we said, is conveyed to the flower and fruit; but no matter of increase is furnished from the flowers or their stalks, as from leaves, to the part of the branch below them, or indeed to any other part. There can be no doubt that certain parts of the flower perform functions as to air and light analogous to those of leaves, but entirely subservient to the benefit of the flower and fruit. Their secretions, formed from the returning sap, are confined to their own purposes. As soon as these are

accomplished, a decided separation of vessels takes place, and the ripe fruit, accompanied perhaps by its stalk, falls from the tree.

All this should help us to form some general idea of the manner in which the peculiar secretions of plants are produced; but when we attempt to consider how the particular secretions of different species and tribes of plants are formed,—how the same soil, the same atmosphere, should in a leaf of the vine or sorrel produce a wholesome acid, and in that of a spurge or manchineel a most virulent poison,—how sweet and nutritious herbage should grow among the acrid crowfoot and aconite,—we find ourselves totally unable to comprehend the existence of such wonderful powers in so small and seemingly simple an organ as the leaf of a plant. The agency of the vital principle alone can account for these wonders, though it cannot, to our understanding, explain them. All these operations, indeed, are evidently chemical decompositions and combinations; but the thickest veil covers the whole of these processes; and so far have philosophers hitherto been from removing this veil, that they have not even been able to approach it. The vain Buffon caused his own statue to be inscribed, "A genius equal to the majesty of nature," but a blade of grass was sufficient to confound his pretensions. Sir J. E. Smith.

Leaves.—Leaves, which consist of fibres arranged in a kind of network, not only contribute to the beauty of plants, but perform functions of essential importance to them. They are, as is well known, of various shapes and of different sizes. Some are so small as to be microscopic objects, and others, those of the Talipot palm for instance, so large as to measure above 30 feet in circumference. They also fall at different times, and are differently denominated according to the period of their fall, being caducous, deciduous, persistent, or perennial, according as they fall in summer, in autumn, in spring, or only in the course of years. Their use in the vegetable economy is now well understood, it being unquestionably

ascertained that they serve as lungs to the plant. The sap being carried into them by one set of vessels, is there spread out and exposed to the action of air and light, and exhales its superabundant moisture, and having undergone certain chemical changes (probably analogous to those undergone by the blood in the lungs), is received into another set of vessels, to be conducted downwards and distributed in the cortical cells, depositing there the various secretions requisite for the nourishment, health, and preservation of the stem and root.

Leaves perspire and absorb a considerable quantity of moisture, in some cases sensibly, but in general insensibly. A branch which, after being gathered, has had its wound stopt with wax, will speedily wither in a dry atmosphere; but it may be made to recover by removing it to a damp situation. Haymakers are quite familiar with the fact, that, in moist weather, it is next to impossible to get their hay-harvest lodged in safety; and every one has observed the effects of a hot day in causing plants to droop, and of a moist one in causing them to flourish. The great annual sunflower is said to perspire in a hot dry day, in 12 hours, not less than 1 lb. 14 oz.; and the cornelian-cherry is a still more remarkable instance, evaporating, it is said, moisture equivalent to twice the weight of the whole shrub in 24 hours. The effect of light upon leaves is also worthy of notice. It is understood to be the cause of their green colour. Leaves raised in the dark are invariably of a sickly white colour; and the blanching of celery, it is well known, is effected by covering up the plant from the light. Light, it is singular also, whilst it benefits the upper, injures the under sides of leaves; and none can have attended to fruit-trees without remarking, that they invariably turn, not only their leaves, but their branches towards the light. If leaves are disturbed, they will turn again to their former position, and quicker, too, in proportion to the intensity of the light. A field of clover following the course of the sun, although a familiar spectacle, does not less distinctly prove the influence of light on leaves than does

the turning of the sunflower, the marigold, the daisy, &c. prove the influence of light upon flowers. We ought not to omit quoting, *en passant*, the striking remark of Sir J. E. Smith in reference to the last-mentioned plants, that Nature, in their forms, seems to have imitated the radiant luminary to which they are apparently dedicated.

But the most remarkable fact respecting leaves, perhaps, is the reciprocal action of them and the atmosphere upon each other. This chemical change, which is called the respiration of plants, was discovered by Dr Priestley. During exposure to the direct rays of the sun, leaves absorb carbonic acid gas from the air, and emit oxygen in return. In the dark, an opposite effect ensues. Carbonic acid gas is not absorbed, nor is oxygen evolved; but, on the contrary, oxygen disappears, and carbonic acid gas is disengaged. In the sunshine, therefore, vegetables purify the air, but in the dark they deteriorate it, producing in the latter instance the same effect as the respiration of animals, but in the former a contrary effect.

The Seed.—THE seed, from which the future plant proceeds, is the sole end and aim of all the parts of fructification. It consists of several parts, the most essential of which is the *Embryo* or germ, called by Linnæus *Corculum*, whence the life and organization of the future plant originate. The *Cotyledons*, or seed-lobes, are immediately attached to the embryo, of which they form, properly speaking, a part; and they are commonly two in number, and, when the seed has sufficiently established its root, generally rise out of the ground, and form a kind of leaves. *Hilum*, the scar, is the point by which the seed is attached to its seed-vessel, or receptacle, and through which alone nourishment is imparted for the perfecting of its internal parts; it is also the point through which the radicle is protruded in the first stage of germination.

There is no part of the vegetable kingdom which affords so many striking proofs of admirable contrivance as the seed. The care which Nature has bestowed upon it is astonishing. Independently of the innumerable means

which are adopted for maturing and protecting the organs on which the production of the seed depends, and which form part of the system of provision for perfecting it,—independently, too, of the countless contrivances, some highly artificial, for the immediate purpose of perfecting it,—the mode in which this organ is *preserved* after it is matured, evinces consummate care and wisdom. Sometimes it is packed up in a capsule, a vessel composed of tough and strong coats; sometimes, as in stone-fruits and nuts, it is enclosed in a strong shell, which again is enclosed in a pulp; sometimes, as in grapes and berries, it is plunged overhead in a glutinous syrup contained within a skin or bladder; at other times, as in apples and pears, it is embedded in the heart of a firm fleshy substance; or, as in strawberries, pricked into the surface of a soft pulp. These, and many other varieties, exist in what are called fruits. In pulse, and grain, and grasses,—in trees, and shrubs, and flowers,—the variety of the seed-vessels is incomputable. We have the seeds, as in the pea-tribe, regularly disposed in parchment pods, which completely exclude the wet; the pod also, not seldom, as in the bean, lined with a fine down distended like a blown bladder; or we have the seed enveloped in wool, as in the cotton-plant; lodged, as in pines, between the hard and compact scales of a cone; or barricaded, as in the artichoke and thistle, with spikes and prickles; in mushrooms, placed under a penthouse; in ferns, variously sheltered on the back part of the leaf; or, we find them covered by a strong close tunicle, and attached to the stem according to an order appropriated to each plant, as is seen in several kinds of grain and of grasses.

Equally numerous and admirable are the contrivances for *dispersing* seeds. Who has not listened, in a calm and sunny day, to the crackling of furze-bushes, caused by the explosion of their little elastic pods; or watched the down of innumerable seeds floating on the summer breeze, till they are overtaken by a shower, which, moistening their wings, stops their further flight, and at the same time accomplishes its final purpose by immediately promoting the germination of each seed in the moist earth!

How little are children aware, as they blow away the seeds of the dandelion, or stick burs in sport on each other's clothes, that they are fulfilling one of the great ends of Nature! The awns of grasses answer the same purpose. Pulpy fruits serve quadrupeds and birds as food, while their seeds, often small, hard, and indigestible, pass uninjured through the intestines, and are deposited, far from their original place of growth, in a condition peculiarly fit for vegetation. Even such seeds as are themselves eaten, like the various sorts of nuts, are hoarded up in the ground, and occasionally forgotten, or carried to a distance, and in part only devoured. The ocean itself serves to waft the larger kind of seeds from their native soil to far-distant shores.

Germination.—LET us endeavour to illustrate the subject of Germination, by taking a view of what happens to a bean after it has been committed to the earth. In a few days, sooner or later according to the temperature of the weather and disposition of the soil, the external coverings open at one end, and disclose part of the body of the germ. This substance consists of two lobes, between which the seminal plant is securely lodged. Soon after the opening of the membrane, a sharp-pointed body appears, which is the root. By a kind of instinctive principle (if the expression may be allowed) it seeks a passage downward, and fixes itself into the soil. At this period the root is a smooth and polished body, and has perhaps but little power to absorb anything from the earth for the nutriment of the germ. The two lobes next begin to separate, and the germ, with its leaves, may be plainly discovered. As the germ increases in size, the lobes are farther separated, and the tender leaves, being closely joined, push themselves forward in the form of a wedge. These leaves take a contrary direction to that of the root: they seek a passage upward; which, having obtained, they lay aside their wedge-like form, and spread themselves in a horizontal direction, as being the best adapted for receiving the rains and dew. The radicle, every hour increasing in size and vigour, pushes

itself deeper into the earth, from which it now draws some nutritive particles. At the same time the leaves of the germ, being of a succulent nature, assist the plant by attracting from the atmosphere such particles as the tender vessels are fit to convey. These particles, however, are of a watery kind, and have not in their own nature a sufficiency of nutriment for the increasing plant. Vegetables, as well as animals, during their tender state, require a large share of balmy nourishment. As soon as an animal is brought to life, the milk of its mother is supplied in a liberal stream; and the tender vegetable lives upon a similar fluid, though differently supplied. For its use the farinaceous lobes are melted down into a milky juice, which is conveyed to the plant by means of innumerable small vessels which are spread through the substance of the lobes; and which, uniting into one common trunk, enter the body of the germ, and thus supply that balmy liquor, without which the plant must inevitably have perished, its root being then too small to absorb a sufficiency of food, and its body too weak to assimilate it into nourishment. Thus admirable and well-contrived is the method of Providence in supporting the plant in its earliest and tenderest stages! As the plant increases in size, the balmy juice diminishes, till at last it is quite exhausted. The trunk of small vessels then dries up, and the external covering of the seed appears connected with the root in the form of a shrivelled bag.—In the process of vegetation there is no mortality; from the moment that the seed is lodged in its parent earth, the vegetative soul begins its operations, and, in the whole successive gradation of them, illustrates the wisdom, power, and bounty of the Creator. Dr O. GREGORY.

Adaptation of Plants to their Situations.—"Now, Philanthes, that we have reached the arbour, sit down and inform me what part of the vegetable economy you have been studying lately."

"I have been tracing the adaptation of flowers, in respect to shape and colour, to the sites in which they grow; and, since you wish it, I shall enumerate a few of

the most striking instances that I have remarked. *Papilionaceous* flowers are effectually defended from storms of wind and rain by the beautiful pavilions with which they are furnished. They are mounted on elastic stems, by means of which they are enabled to turn like weather-cocks, and present their backs to the driving storms; and this provision is as wise as it is ornamental, for this class is generally found in places exposed to wind. In like manner the *fern*, which frequently crowns the summits of exposed situations, has its fructification arranged on the under-surface of the leaf, and turned towards the earth; whilst the white archangel, which grows on the sides of grassy banks, where every blade serves as a conduit for the water in showery weather, has its petals beautifully curved over the defenceless seeds. Corollas, you know, are designed to catch the rays of the sun; and in cases where they are divided into separate petals, they are often arranged so as to form an assemblage of polished mirrors directing the heat to one focus. It is remarkable, however, that, when the situation of the plant renders it necessary to dissipate rather than collect the heat, this arrangement is interrupted, and the petals are so disposed as to preclude any reflection from their polished surface on the interior of the flower. This last arrangement is particularly conspicuous in the white lily. Notwithstanding the large size and dazzling whiteness of its corolla, the more it expands, the more it disperses the solar heat; and whilst on a midsummer's noon most of the flowery tribes droop their parched heads upon the ground, the lily rears her head, the empress of the garden, and contemplates, face to face, the meridian sun. Trumpet-shaped flowers, such as the *convolvulus*, convey as much heat as possible to the interior; and it is very remarkable, that this configuration is generally given to those which grow among high grass, or under the shade of trees. This wonderful adaptation is manifest, too, in the colours of flowers. White is well known to be peculiarly calculated for reflecting heat; and is it not for this reason that Nature has invested with this colour those flowers which blow in cold seasons and situations; the

snowdrop, for instance, the *lily of the valley*, *wood-sorrel*, &c.? Indeed, almost all spring-flowers are remarkable for their light colours. Those of the summer, on the contrary, are robed in tints of the most brilliant kind, fitted to absorb the sunbeams without reflecting them in any considerable degree."

"You have spoken of the adaptation of the shape and colour of our common flowers to their respective situations, but you may extend the remark to every class of vegetables. The plants of different countries have separate and peculiar characters, according to the nature of the soil in which they grow, and to the degree of solar heat to which they are exposed. Plants of the polar regions, for example, are generally low, with small close-set leaves, and flowers proportionally large; those of Europe are divested of showy leaves, and are in many instances furnished with catkins; the Asiatic countries are particularly rich in splendid flowers; whilst those of Africa have generally succulent leaves and variegated flowers. The extraordinary manner in which Nature has adapted *individual* plants, too, to their respective stations, is not less worthy of attention; and as I know you are fond of tracing such evidences of the hand of Him who is 'wonderful in counsel and excellent in working,' I shall mention a few striking instances.

"The cypress of Louisiana grows with its roots in water, and is principally found on the banks of the Missisipppi. The circumference of the trunk is nearly thirty feet; and, in order to enable it to resist the floating masses of ice which, at the breaking up of the wintry season, come down in great quantities from the northern lakes, there are several large protuberances, acting as buttresses, evidently designed to protect the base. These protuberances are round and smooth: they have neither leaves nor branches, and therefore cannot be considered as shoots; they are in fact ice-breakers. The branches of the *honeysuckle* shoot longitudinally, till they become unable to bear their own weight, and then strengthen themselves by changing into a spiral form. When they meet with other living branches of the same kind, they

coalesce for mutual support, and one spiral turns to the right, and the other to the left; thus seeking, by an instinctive impulse, some object on which to climb, and increasing the probability of finding one by the diversity of their course; for if the auxiliary branch be dead, the other uniformly winds itself round from right to left. Plants which thus attach themselves to others are called *parasitic*, and are divided into two classes, the ornamental and injurious. The *caraguata*, a plant of the West Indies, is a striking instance of the latter. It clings round the nearest tree, and, soon gaining the ascendency, covers the branches with a foreign verdure, robs them of nourishment, and at last destroys its supporter."

"The distinguishing characteristics of the last you have mentioned may, I think, be found among our own species. The despot who tyrannizes over the people from whom he has derived his power; the statesman who builds his greatness on the ruins of the country that nourished him; and the profligate youth who reduces a too-indulgent father to penury by his extravagance;—all belong to the class of the *caraguata*."

"Have you ever turned your attention to aquatic plants, Philanthes? Their adaptation to their respective situations is very remarkable. One of the most curious of aquatic plants is the *vallisneria*, which grows abundantly in the Rhine. Whilst the roots are fixed at the bottom of the river, the flowers float on the surface of the water, and are furnished with an elastic spiral stalk, which dilates and contracts as the water rises and falls.—The leaves of land-vegetables perform the office of lungs, by exposing a large surface of vessels to the influence of air; aquatic ones also answer a similar purpose, like the gills of fish. As the materials which are necessary to life apparently abound much more in air than water, the sub-aquatic leaves of many plants are cut into fine divisions to increase the surface; whilst those above the water continue undivided. It is equally remarkable, that the plants of lofty mountains have their upper leaves much more serrated than the lower, because the air is rarer, and a larger surface of contact is necessarily required."

CHARACTER OF THE LATE REV. DR HARDIE OF ASHKIRK.

In Dr Hardie learning and knowledge were blended with the most unassuming modesty; and moral excellence was tempered by a gentleness of spirit which shed over his character peculiar grace. If natural reserve gave to his manners on a first acquaintance the air of constraint or formality, that appearance was quickly dispelled; and, delighting in the intercourse of friendship, his conversation was frank, liberal, original, and useful. His heart was the seat of kindness and compassion, and not merely his studies, but even his relaxations, were directed to the promotion of the welfare of his fellow-creatures. The time which he employed in supplying an important desideratum in the education of the lower classes, by preparing an admirable collection under the title of "Extracts for Parish Schools," affords a convincing proof, that he could stoop to the humblest office, when it was in his power to do good. His voice in public was somewhat feeble, but this was amply compensated by the fineness of its modulation and tones; while the choice of his subjects, the elegant perspicuity of his style, the pleasing expression of his countenance, the growing earnestness and pathetic warmth of his manner as he advanced in his address, the closeness of his reasoning, and the chastened luxuriance of his fancy, entitled him to be ranked in the first class of Scottish preachers, and in that class to hold a distinguished place. In the sequestered spot to which his professional labours as a minister of the Church of Scotland were chiefly confined, his virtues were best known, and most highly appreciated. Long among his people will be the remembrance of his worth, and deep the sorrow which his early removal will excite. If the untimely loss of a character, such as we have faintly delineated, be severe to his family, to his friends, and to his country, the lesson which it affords is solemn and impressive. Let us bow with reverence to the will of Heaven, and learn to look beyond a world in which there is "nothing perpetual but change."

Rev. Robert Lundie.

THE MECHANICAL POWERS.

Nature has placed at the disposal of man various mechanical agents, endued with different kinds and degrees of power. The weight of solid bodies, and their momentum when in motion; the weight and pressure of liquids; the weight and pressure of air and other gases; the elastic force of vapour raised from liquids by heat; the elasticity of springs, and the muscular strength of animals, furnish striking examples. In applying these forces to overcome resistances, or to communicate motion to bodies, it seldom happens that, without some previous modification, they are capable of accomplishing the end we desire to attain. The power which we may happen to have at our disposal may not act in the proper direction, or may not have that velocity or intensity which suits our purpose; and some contrivance must be found by which,—in transmitting it to the working-point,—its direction, velocity, or intensity, may be regulated in such a manner as to be suitable to the purpose to which it is to be applied. Such a contrivance is called a *machine*.

Every machine, however complex, must consist of some combination of the simple machines, called the *mechanical powers;* these are six in number, the lever, the wheel and axle, the pulley, the inclined plane, the wedge, and the screw.

Every one has seen men raising a stone by means of a bar of iron. This bar is a *Lever*. In this machine three things are to be considered, the power which presses on it, the weight to be raised, and the prop on which it rests. The advantage results from having the power much farther from the prop than the weight is from it. If the distance of the power from the prop be four times as great as that of the weight from it, the advantage will be as 4 to 1. If it be six times as great, the advantage will be as 6 to 1; and, generally, the power bears to the weight an inverse ratio to the arms of the lever. Levers are of three kinds:—First, when the prop is between

the weight and power;—Second, when the weight is between the prop and power;—Third, when the power is between the weight and prop. It is by a lever of the *first* kind that a seaman moves his rudder, a blacksmith his bellows, and that a boy opens and shuts the locks of a canal. Gates and doors are levers of the *second* kind, and the hinge is the prop on which they move. A pair of tongs, a spade, a pitchfork for raising hay, and a ladder, whilst in the act of being raised against the wall, are instances of levers of the *third* kind.—(*See Illustrations, Fig.* 9.)

In the *Wheel and Axle*, a weight is raised by means of a rope coiling round the axle, whilst the power is applied to the outer rim of the wheel. The advantage gained is in proportion to the extent to which the width or diameter of the wheel exceeds that of the axle. The semi-diameter of the wheel, and the semi-diameter of the axle, may be considered as levers of which the centre is the common prop. An equilibrium will be produced when the power is to the weight as the semi-diameter of the axle is to the semi-diameter of the wheel, or as the circumference of the axle is to the circumference of the wheel. In raising weights with this machine the rope coils round the axle and enlarges the diameter; hence the advantage of the power is continually diminishing; and, accordingly, in raising a bucket from a deep well the weight is felt much more sensibly as it approaches the top. The most common and useful applications of the wheel and axle are the crane used on wharfs and quays for drawing goods up from a ship, and the capstan for lifting the anchors, &c. of ships.—(*See Illustrations, Fig.* 10.)

The *Pulley* is a well-known machine, and is used principally in managing the rigging of ships. A single pulley gives no mechanical advantage, but it is of use in altering the direction in which a force may be applied. If two pulleys be used, the power will keep in equilibrio a weight double its own; if three be used, the power will balance three times as much, and so on. In this machine the advantage is greatly diminished by the friction of the axles and the want of pliancy in the ropes. It may be

regarded as to principle either as a modification of the lever, or as a distinct mechanical power.—(*See Illus. Fig.* 11.)

The *Inclined Plane* is used for the purpose of facilitating the raising of great weights. It is evidently much easier to roll a cask along a plank into a waggon than to raise it from the ground. In the inclined plane an equilibrium is produced when the power is to the weight as the height of the plane is to the length of its sloping side; but as the friction in the use of this machine is very great, a much less power than that found by calculation will keep a body in equilibrio, and a much greater power will be requisite to draw it upwards.—(*See Illustrations, Fig.* 12.)

The *Wedge* is a well-known mechanical power. The law of its equilibrium is, that the power should be to the weight as half the length of the back is to the length of one of the sides; but, on account of friction and other causes, no law can be stated as universally accurate. In real practice, all that we can say is, that the less the breadth of the back in proportion to the length of the side, the greater is the advantage. Nature, whose works uniformly display the utmost wisdom in their design, has formed the beaks of birds wedge-shaped for the purpose of enabling them to dig into the ground, &c. The figure of a bird, too, is similarly fitted for cleaving the air, as is also that of the breastbones of waterfowl. (May not the shape of boats and ships have been first suggested by the shape of these animals?) A grand military evolution of the ancients was forming a battalion into the shape of a wedge; and many instances occur in history of an enemy's line having been broken by this contrivance.—(*See Illus. Fig.* 13.)

The principle of the *Screw* is the same as that of the inclined plane. The weight, instead of proceeding straight forward, moves in a spiral direction, gradually ascending to the top; and the equilibrium is calculated in the same manner as in the inclined plane.

PRESSURE OF WATERY FLUIDS.

ALL the particles of fluids are so connected together, that

they press equally in every direction, and are equally pressed upon; each particle presses equally on all the particles that surround it, and is equally pressed upon by these; it equally presses upon the solid bodies which it touches, and is equally pressed upon by those bodies. From this, and from its gravity, it follows, that when a fluid is at rest, and left to itself, its surface will rise or fall so as to settle at the same level, no part standing above or sinking below the rest. Hence if we pour water or any other liquid into a tube or pipe bent double like a U, it will stand at the very same height in both limbs. Nor does it make any difference if one limb is wider than the other. Generally, and in every case, if there be two tubes or limbs of a tube connected together, however different their width may be, a fluid poured into them will stand at the same level, and thus a portion of fluid, however small, will resist the pressure of a portion, however large, and balance it.—(*See Illustrations*, *Fig.* 14.)

From these considerations two most important conclusions follow; the one is, that water, by being confined in pipes or close channels of any kind, will rise to the height from which it came, that is, as high as its source; and upon this principle depend all the useful contrivances for conveying water by pipes, in a way far more easy, cheap, and effectual than those vast buildings called aqueducts, by which the ancients carried their supplies of water in artificial rivers over arches for many miles. The other is not less true, but far more extraordinary, and indeed startling to our belief, if we did not consider the reasoning upon which it is founded; it is, that the pressure of the water upon any object is not at all in proportion to the bulk of the water, but only to the size of the surface on or against which it presses, and its own height above that surface; in other words, that any quantity of water, however small, may be made to support any quantity, however great. This principle is called the *Hydrostatical paradox; paradox* signifying something which, though true, appears, when first considered, to be untrue. We are at first startled by the apparent impossibility of

the statement. But when we come to examine it more closely, we find it to be accurately true; for the small tube in the case just mentioned may be made ever so narrow, and to hold ever so little water, while the wide tube communicating with it may be made ever so large, and holding ever so much water; and the level at which the water stands in both tubes will be the same.

Everything thus depending upon the height and the surface, and nothing upon the bulk of the fluid, we may easily perceive what mischief may be done by a very small quantity of water, if it happens to be applied or distributed so as to stand high, in however thin a body or column, and to spread over a wide but confined and shallow space. This may be easily tried with a hogshead of water, or any other liquid, by fixing a small strong pipe in the bunghole, and pouring water through it; when the water rises in the pipe to a sufficient height (and this will be more or less according to the strength of the barrel), the barrel will burst, although but a very small quantity of water may have been poured into the pipe.

The same effect may be produced naturally, by the rain falling into and filling some long narrow chink that may have been left in the walls of a building, or may be made by its decay in the course of time; and whether the chink be equally wide throughout, or vary in its size, and whether it be straight like a pipe, or crooked, makes no difference; provided it is water-tight, so as to get full of the rain, the pressure will always be in proportion to its perpendicular height, and not to its length if it winds. The same process in nature may produce the most extensive devastation; it may cause earthquakes, and split or heave up mountains. Suppose in the bowels of some mountain there should be an empty space of ten yards square and only an inch deep on an average, in which a thin layer of water had lodged so as to fill it entirely; and suppose that in the course of time, a small crack of no more than an inch in diameter should be worn from above 200 feet down to the layer of water; if the rain

were to fill this crack the mountain would be shaken, perhaps rent in pieces with the greatest violence, being blown up with a force equal to the pressure of above 5022 tons of water, though not above a ton and a half altogether had been actually applied. This prodigious power, however, may be applied safely, and even beneficially. In the operations of Nature it is probably an important agent; and it is capable of being applied advantageously in the operations of art.

Library of Useful Knowledge.

THE HOLY LAND.

PALESTINE, the land of Israel, the kingdom of David and Solomon, the most favoured and the most guilty country under Heaven,—during between two and three thousand years the only section of the earth where the worship of the true God was perpetuated,—

> " Over whose acres walk'd those blessed feet
> Which eighteen hundred years ago were nail'd,
> For our advantage, to the bitter cross,"—

is a small canton of Syria, included within the limits of the Turkish empire, and governed by the pashas of Acre and Damascus. In the map it presents the appearance of a narrow slip of country, extending along the eastern coast of the Mediterranean; from which, to the river Jordan, the utmost width does not exceed fifty miles. This river was the eastern boundary of the land of Canaan or Palestine, properly so called, which derived its name from the Philistines, or Palestines, originally inhabiting the coast. To three of the twelve tribes, however, Reuben, Gad, and Manasseh, portions of territory were assigned on the eastern side of the river, which were afterwards extended by the subjugation of the neighbouring nations. The territory of Tyre and Sidon was its ancient border on the north-west; the range of the Libanus and Anti-Libanus forms a natural boundary on the north and north-east; while in the south it is pressed

upon by the Syrian and Arabian deserts. The kingdom of David and Solomon, however, extended far beyond these narrow limits. In the north-eastern direction it was bounded only by the river Euphrates, and included a considerable part of Syria. On the east and south-east it was extended by the conquest of the country of Moab, that of the Ammonites, and Edom; and tracts which were either inhabited or pastured by the Israelites lay still further eastward. In the time of David, the people of Israel, women and children included, amounted, on the lowest computation, to five millions, besides the tributary Canaanites, and other conquered nations.

The vast resources of the country, and the power of the Jewish monarch, may be estimated, not only by the consideration in which he was held by the contemporary sovereigns of Egypt, Tyre, and Assyria, but by the strength of the several kingdoms into which the dominions of David were subsequently divided. Damascus revolted during the reign of Solomon, and shook off the Jewish yoke. At his death ten of the tribes revolted under Jeroboam, and the country became divided into the two rival kingdoms of Judah and Israel, having for their capitals Jerusalem and Samaria. The kingdom of Israel fell before the Assyrian conqueror in the year B. C. 721, after it had subsisted about two hundred and fifty years. That of Judah survived about one hundred and thirty years, Judea being finally subdued and laid waste by Nebuchadnezzar, and the Temple burnt, B. C. 588. Idumea was conquered a few years after. From this period till the era of Alexander the Great, Palestine remained subject to the Chaldean, Median, and Persian dynasties. At his death, Judea fell under the dominion of the kings of Syria, and, with some short and troubled intervals, remained subject either to the kings of Syria or of Egypt, till John Hyrcanus shook off the Syrian yoke, and assumed the diadem, B. C. 130. The Asmonean dynasty, which united in the person of the monarch the functions of king and pontiff, though tributary to Roman conquerors, lasted one hundred and twenty-six years, till the

kingdom was given by Antony to Herod the Great, of an Idumean family, B. C. 39.*

At the time of the Christian era, Palestine was divided into five provinces; Judea, Samaria, Galilee, Perea, and Idumea. On the death of Herod, Archelaus his eldest son succeeded to the government of Judea, Samaria, and Idumea, with the title of tetrarch; Galilee being assigned to Herod Antipas, and Perea, or the country beyond Jordan, to the third brother, Philip. But, in less than ten years, the dominions of Archelaus became annexed, on his disgrace, to the Roman province of Syria, and Judea was thenceforth governed by Roman procurators. Jerusalem, after its final destruction by Titus, A. D. 71, remained desolate and almost uninhabited, till the Emperor Hadrian colonized it, and erected temples to Jupiter and Venus on its site. The Empress Helena, in the fourth century, set the example of repairing in pilgrimage to the Holy Land, to visit the scenes consecrated by the Gospel narrative, and the country became enriched by the crowds of devotees who flocked there. In the beginning of the seventh century, it was overrun by the Saracens, who held it till Jerusalem was taken by the Crusaders in the twelfth. The Latin kingdom of Jerusalem continued for about eighty years, during which the Holy Land streamed continually with Christian and Saracen blood. In 1187, Judea was conquered by the illustrious Saladin; on the decline of whose kingdom it passed through various revolutions, and at length, in 1317, was finally swallowed up in the Turkish empire:

"Trodden down
By all in turn, Pagan, and Frank, and Tartar,—
So runs the dread anathema,—trodden down
Beneath the oppressor; darkness shrouding thee
From every blessed influence of heaven;
Thus hast thou lain for ages, iron-bound
As with a curse. Thus art thou doom'd to lie,
Yet not for ever."

* Thirty-five years before the true date of our Lord's birth, which is computed to have taken place four years before the vulgar era.

The general outlines of the surface of the country may be thus laid down. The Jordan, or river of Dan, which rises under the lofty peaks of the Anti-Libanus, and flows in a direction almost constantly southward, with the lake of Tiberias, through which it passes, and that of Asphaltites (the Dead Sea), which it forms by its discharge, divides Palestine completely from north to south. In the western division, between the Mediterranean and the lake of Tiberias, lie the two Galilees. The plain of Esdraëlon, which occupies the greater part of this tract, being two days' journey, or nearly fifty miles in length, and twenty in breadth, is described by Dr Clarke as one vast meadow, covered with the richest pasture. This plain is enclosed on all sides by the mountains, and not a house or a tree is to be discovered in it. It is completely commanded by Acre, so that the possessor of that port is the lord of one of the richest territories in the Holy Land. To the south of Galilee lies the district of ancient Samaria, now chiefly included in the district of Nablous; it is mountainous, but well cultivated, and forms at present the most flourishing part of the Holy Land. Judea Proper comprises the territory extending from the Dead Sea to the Mediterranean, and is composed of a range of limestone hills, rising by stages from the level of the coast, and becoming more rugged and rocky as you approach Jerusalem from Jaffa. Between Jaffa and Gaza, westward of the mountains of Judea, lies the tract distinguished as the plain of the Mediterranean Sea, the ancient territory of the Philistines, including the five cities of Gaza, Askelon, Ashdod, Gath, and Ekron. This district still bears the name of Phalastin, and forms a separate pashalic; it may be distinguished as Palestine Proper.

CONDER—*Modern Traveller.*

HYMN OF THE HEBREW MAID.

WHEN Israel, of the Lord beloved,
  Out from the land of bondage came,

Her father's God before her moved,
  An awful guide, in smoke and flame.
By day along the astonish'd lands
  The cloudy pillar glided slow;
By night Arabia's crimson'd sands
  Return'd the fiery pillar's glow.

There rose the choral hymn of praise,
  And trump and timbrel answer'd keen;
And Zion's daughters pour'd their lays,
  With priests' and warriors' voice between.
No portents now our foes amaze,
  Forsaken Israel wanders lone;
Our fathers would not know Thy ways,
  And Thou hast left them to their own.

But present still, though now unseen!
  When brightly shines the prosperous day,
Be thoughts of Thee a cloudy screen
  To temper the deceitful ray.
And oh! when stoops on Judah's path,
  In shade and storm, the frequent night,
Be Thou, long-suffering, slow to wrath,
  A burning and a shining light.

Our harps we left by Babel's streams,
  The tyrant's jest, the Gentile's scorn;
No censer round our altar beams,
  And mute are timbrel, trump, and horn.
But Thou hast said,—"The blood of goat,
  The flesh of rams, I will not prize;
A contrite heart, an humble thought,
  Are mine accepted sacrifice."

Sir WALTER SCOTT.

CAPILLARY ATTRACTION.

It is the general rule, that no liquid can of itself rise higher in the inside of a tube than it stands on the outside; but there is an exception to this rule which requires to be explained.

If a drop of water, or any liquid of a like degree of fluidity, be pressed upon a solid surface, it will wet that

surface and stick to it, instead of keeping together, and running off when the surface is held sloping. This shows that the parts of the liquid are more attracted by the parts of the solid than by one another. In the same manner, if you observe the edge of any liquid in a vessel, as wine in a glass, and note where it touches the glass, you will see that it is not quite level close to the glass, but becomes somewhat hollow, and is raised up on it, so as to stand a little higher at the edge than in the middle and other parts of its surface. It appears, therefore, that there is an attraction, at very small distances from the edge, sufficient to suspend the part of the fluid near it, and prevent it from sinking to the level of the rest. Suppose the wine-glass to be diminished, so as to leave no room for any of the wine in the middle which lies flat and level, but only to leave room for the small rim of liquor raised up all round on the side of the glass,—in other words, suppose a very small tube, placed with its lower end just so as to touch the liquor; it is evident that the liquor will stand up somewhat higher in the tube than on the outside; and if the tube be made smaller and smaller, the liquor will rise higher, there being always less weight of liquid to counterbalance the attraction of the glass.

Tubes of this very small bore are called *capillary*, from a Latin word signifying *hair*, because they are small, like hairs. Generally, any tube of less than 1-20th of an inch diameter in the inside is a *capillary* tube; and if it is placed so as to touch the surface of water, the water will rise in it to a height which is greater the smaller the bore of the tube is. If the diameter of the tube is 1-50th part of an inch, the water will rise to the height of one inch; if it be 1-100th, the water will rise two inches; if 1-200th, the water will rise four inches, and so on in proportion as the bore is lessened. The action of the tubes upon liquids depends, however, it must be recollected, upon the nature of the solid substances of which they are made. If the glass is smeared with grease so that the water will not stick to it, that liquid will not

rise at all. So, different liquids rise to different heights in the same tube, but not according to their specific gravity. Mercury does not rise at all; on the contrary, it sinks considerably lower than its level outside the tube.

Capillary attraction performs many important offices in nature. Probably the distribution of moisture in the earth is regulated by it; and there is no doubt that the distribution of the juices in plants depends principally upon it. The rise of the sap and its circulation is performed in the fine capillary tubes of the wood and bark, which are the arteries and veins of vegetables. Any one may perceive how this process is performed, by twisting together several threads of cotton or worsted, and wetting them. If they are then put in a glass of any coloured fluid, as red wine or ink, and allowed to hang down to the plate on which the glass stands, the fluid will soon be perceived to creep up, and colour the whole of the threads, red or black, as the case may be; and in a short time the whole contents of the glass will come over into the plate. Capillary tubes may in this manner carry juices upwards, and distribute them through plants. The juice, it is true, cannot be so carried from a lower to a higher level in a capillary tube, and flow out from the top; but it may be carried upwards in one, and then flow horizontally into others; and from these it may be carried upwards again in a third set of tubes; or it may be carried in any direction by capillary syphons. Spongy bodies act in all probability on liquids in the same manner, by means of a great number of extremely small capillary tubes, of which their substance is entirely composed. *Library of Useful Knowledge.*

THE TEMPLE OF FAME.

THE Temple shakes, the sounding gates unfold,
Wide vaults appear, and roofs of fretted gold,
Raised on a thousand pillars wreath'd around
With laurel-foliage and with eagles crown'd;
Of bright transparent beryl were the walls,
The friezes gold, and gold the capitals:

As heaven with stars, the roof with jewels glows,
And ever-living lamps depend in rows.
Full in the passage of each spacious gate
The sage historians in white garments wait:
Graved o'er their seats, the form of Time was found,
His scythe reversed, and both his pinions bound.
Within stood heroes, who through loud alarms
In bloody fields pursued renown in arms.
High on a throne, with trophies charged, I view'd
The youth that all things but himself subdued;
His feet on sceptres and tiaras trod,
And his horn'd head belied the Libyan god.
There Cæsar, graced with both Minervas, shone;
Cæsar, the world's great master, and his own;
Unmoved, superior still in every state,
And scarce detested in his country's fate.
But chief were those, who not for empire fought,
But with their toils their people's safety bought:
High o'er the rest Epaminondas stood:
Timoleon, glorious in his brother's blood:
Bold Scipio, saviour of the Roman state,
Great in his triumphs, in retirement great;
And wise Aurelius, in whose well-taught mind
With boundless power unbounded virtue join'd,
His own strict judge, and patron of mankind.
  Much-suffering heroes next their honours claim,
Those of less noisy and less guilty fame,
Fair Virtue's silent train: supreme of these
Here ever shines the godlike Socrates;
He whom ungrateful Athens could expel,
At all times just but when she sign'd the shell:
Here his abode the martyr'd Phocion claims,
With Agis, not the last of Spartan names:
Unconquer'd Cato shows the wound he tore,
And Brutus his ill Genius meets no more.
  But in the centre of the hallow'd choir,
Six pompous columns o'er the rest aspire;
Around the shrine itself of Fame they stand,
Hold the chief honours, and the Fane command.
High on the first the mighty Homer shone;
Eternal adamant composed his throne;
Father of verse! in holy fillets drest,
His silver beard waved gently o'er his breast:

Though blind, a boldness in his looks appears;
In years he seem'd, but not impair'd by years.
The wars of Troy were round the pillar seen:
Here fierce Tydides wounds the Cyprian Queen;
Here Hector glorious from Patroclus' fall,
Here dragg'd in triumph round the Trojan wall.
Motion and life did every part inspire,
Bold was the work, and proved the master's fire.
A strong expression most he seem'd to affect,
And here and there disclosed a brave neglect.
A golden column next in rank appear'd,
On which a shrine of purest gold was rear'd;
Finish'd the whole, and labour'd every part,
With patient touches of unwearied art:
The Mantuan there in sober triumph sate,
Composed his posture, and his look sedate:
On Homer still he fix'd a reverent eye,
Great without pride, in modest majesty.
In living sculpture on the sides were spread
The Latian wars, and haughty Turnus dead:
Elissa stretch'd upon the funeral pyre,
Æneas bending with his aged sire:
Troy flamed in burning gold, and o'er the throne
Arms and the Man in golden ciphers shone.
Four swans sustain a car of silver bright,
With heads advanced, and pinions stretch'd for flight
Here, like some furious prophet, Pindar rode,
And seem'd to labour with the inspiring God.
Across the harp a careless hand he flings,
And boldly sinks into the sounding strings.
The figured games of Greece the column grace,
Neptune and Jove survey the rapid race.
The youths hang o'er their chariots as they run;
The fiery steeds seem starting from the stone:
The champions in distorted posture threat;
And all appear'd irregularly great.
Here happy Horace tuned the Ausonian lyre
To sweeter sounds, and temper'd Pindar's fire;
Pleased with Alcæus' manly rage to infuse
The softer spirit of the Sapphic Muse.
The polish'd pillar different sculptures grace;
A work outlasting monumental brass.

Here smiling Loves and Bacchanals appear,
The Julian star, and great Augustus here:
The Doves, that round the infant Poet spread
Myrtles and bays, hang hovering o'er his head.
Here, in a shrine that cast a dazzling light,
Sate, fix'd in thought, the mighty Stagyrite:
His sacred head a radiant zodiac crown'd,
And various animals his sides surround:
His piercing eyes, erect, appear to view
Superior worlds, and look all Nature through.
With equal rays immortal Tully shone;
The Roman rostra deck'd the Consul's throne:
Gathering his flowing robe, he seem'd to stand
In act to speak, and graceful stretch'd his hand.
Behind, Rome's Genius waits with civic crowns,
And the great Father of his country owns.
These massy columns in a circle rise,
O'er which a pompous dome invades the skies:
Scarce to the top I stretch'd my aching sight,
So large it spread, and swell'd to such a height.
Full in the midst proud Fame's imperial seat
With jewels blazed magnificently great:
The vivid emeralds there revive the eye,
The flaming rubies show their sanguine dye,
Bright azure rays from lively sapphires stream,
And lucid amber casts a golden gleam,
With various-colour'd light the pavement shone,
And all on fire appear'd the glowing throne;
The dome's high arch reflects the mingled blaze,
And forms a rainbow of alternate rays.
When on the goddess first I cast my sight,
Scarce seem'd her stature of a cubit's height;
But swell'd to larger size the more I gazed,
Till to the roof her towering front she raised;
With her the temple every moment grew,
And ampler vistas open'd to my view:
Upward the columns shoot, the roofs ascend,
And arches widen, and long aisles extend,
Such was her form, as ancient Bards have told,
Wings raise her arms, and wings her feet infold;
A thousand busy tongues the Goddess bears,
A thousand open eyes, a thousand listening ears.

Beneath, in order ranged, the tuneful Nine
(Her virgin handmaids) still attend the shrine:
With eyes on Fame for ever fix'd, they sing:
For fame they raise their voice, and tune their string:
With Time's first birth began the heavenly lays,
And last eternal through the length of days. POPE.

A CHANGE OF CHARACTER AS NECESSARY AS A CHANGE OF STATE.

THE Scriptures unequivocally declare, that all mankind have lost both the favour and the moral image of God. By this loss of his favour we are all legally excluded from his family, and consequently can have no interest in its privileges. Since this loss has been incurred by guilt, it is necessary to its removal that our sins be pardoned, and our persons accepted as righteous. This is a change of *state*. But, as we have lost the image of God as well as his favour, it is also necessary to our salvation that we be conformed to the Divine character by a change of *mind*. Could we suppose a sinner to be pardoned, and admitted into the family of God, while no change was effected on his character, he could derive scarcely any benefit from his pardon, because he could have no relish for the holy and spiritual services and enjoyments of the house of God. Were he even admitted into heaven, its hallowed society and its sacred glories would to him be intolerable; for happiness does not result from situation, but from an agreement between faculties and objects, desires and enjoyments. No change can take place in the Divine mind, and, of course, a change must take place in ours; for happiness cannot be enjoyed while our desires and pleasures, our habits, principles, and pursuits, are all opposed to the character and will of God, and to the exercises and enjoyments of his temple. Were a prince to elevate a slave to a station of eminence, while all the habits of a state of slavery remained, this change of condition, without a change of views, feelings, and dispositions, would embarrass and encumber. There is a suitableness between circumstances and character which is essential to ease and

enjoyment; and it is the glory of the Gospel, that, while it elevates to the family of God, it implants and cherishes a spirit becoming it.

This subject will be better illustrated by considering man as diseased as well as condemned, in both which lights he is represented in Scripture. Should a man be imprisoned and condemned to death for a breach of the laws, and should he, while in this state, be seized with the jail-fever to such a degree as to ensure his death by the disease, independently of a public execution according to his sentence, and were he in this state to receive a pardon from his prince, of what use would it be to him? His prison-doors are set open, but the diseased man cannot leave prison; his life is spared by his prince, but it falls a victim to his disorder,—a disorder, too, occasioned by his crime. But if his prince, at the time he pardoned him, could rebuke his disorder, and restore him to health, then, and only then, could the benefit of the pardon be enjoyed. The same is the case with mankind. We are under a judicial sentence of condemnation; but we are at the same time under the power of the disease of sin; we are depraved in heart, alienated from God, hostile to his true character and will, and utterly averse from the holy and spiritual blessings and pleasures of his family. Though we cannot but seek happiness, we naturally seek it not in God, but in the creature. The favour of God in his true character is not the object of desire; the thought of immediate fellowship with him rather pains than attracts us; and a life beyond the grave, in a state of separation from the objects of sense, is considered the ruin of our happiness rather than its perfection. This temper of heart, as well as the dread consequent on a sense of guilt, causes us to shun all serious thoughts of death and of eternity.

If, then, we are not delivered from this moral malady, of what use could forgiveness be to us? We should still be miserable; for sin and wretchedness are inseparable, being in the very nature of things connected together by a law as steady and invariable as that which regulates the

planets. The misery consequent upon sin does not arise from the arbitrary frown of Heaven, or from the positive infliction of superior power. When the divine law denounces the infliction of punishment, it declares what will in the very nature of things be the effect of sin to the transgressor,—it adds its sanction to the constitution of nature. Heaven and Hell are, so to say, the names of opposite characters; the former of which is connected with happy effects and consequences, and the latter with all that is wretched and miserable. Till spiritual health, therefore, is restored, or, in other words, till we are conformed to the character of God, we cannot be happy. Even the Almighty, with reverence be it said, cannot otherwise make us truly happy. Hence our Lord has said, "Except a man be born of water, even of the Spirit, he cannot enter into the kingdom of God." He does not ascribe this to the mere will of God, but traces it to the very nature of things. He does not say he *shall* not enter, but "he *cannot* enter into the kingdom of God;" and this is true in relation to this life as well as to that which is to come.

Sin, then, is the disease and the bane of our souls; and, be where we may, we cannot be happy if its poison is left to rage in our hearts. To complete our salvation, the Redeemer therefore died, not only to expiate our guilt, but to sanctify and cleanse us by the washing of regeneration, even the renewing of the Holy Ghost, that he might present us to himself a glorious church, not having spot or wrinkle, or any such thing, but that we should be holy and without blemish. These two blessings, restoration to the family of God and restoration to spiritual health, though in themselves distinct, are communicated together. The former is obtained by the death of Christ, as a medium of forgiveness every way worthy of God; the latter is obtained by the knowledge of this fact, and of the truths illustrated by the revelation of it. RUSSELL.

SPRINGS, RIVERS, AND LAKES.

Springs.—SPRINGS are so many little reservoirs, which receive their waters from the neighbouring ground through small lateral canals, and which discharge their excess either by overflowing or in some other manner. The origin of springs cannot be referred to one exclusive cause; Nature, simple in her general laws, avails herself of a great variety of means; thus, the precipitation of atmospheric vapours, the dissolving of ice, the filtering of sea-waters, and the explosion of subterraneous vapours, probably all concur in the formation of springs. The opinion of the ancients, which attributed the origin of springs to the filtration of the waters of the sea, is not a mere theory. It is true that all running waters have their sources far above the level of the sea. But the phenomena of capillary tubes may obtain in the interior of the earth. The sea-waters, deprived of their salt and bitter elements, may ascend through the imperceptible pores of several rocks, from which, being disengaged by heat, they may form those subterraneous vapours to which many springs owe their origin. We may here quote the example of the Chartreux, who, seeing their springs dried up, and learning that thick vapours were observed to ascend from a neighbouring quarry newly opened, bought the quarry, closed it up, and beheld their springs reappear. To rains, dews, and other aqueous vapours, however, the principal share is assigned in producing running waters; and, in order to be convinced that this is the case, we have only to consider Apulia and other peninsulas, which are almost destitute of running water, simply because their mountains do not constitute a mass sufficient, either from its elevation or its bulk, to attract and retain the aqueous vapours of the atmosphere. On the principle, that it is from the sea the atmosphere exhales its water in the gaseous form, it is easy to explain why the interior of many great continents, such as Africa and Asia, contain such barren deserts.—(*See Illustrations, Fig.* 15.)

Rivers.—As water naturally falls to the lowest level which it can reach, all the rain which is poured down on the earth, and which the earth cannot absorb, is collected in streams, which run down its surface, and, joining each other in their course, are formed into mighty rivers, which finally mingle with the ocean. The rapidity of a river depends on the declivity of its bed. Thus, in the commencement of their course from the high grounds, rivers rush down with all the fury of torrents; and when they are swelled by the rains, or by the melting of the mountain-snows, they come down in irresistible majesty, roaring and foaming between the high and perpendicular banks within which they are contained, till they break out of their steep and rugged prison, and spread their placid waters over the plains. The origin and progress of rivers has been fancifully compared by Pliny to the life of man: "Its beginnings are insignificant and its infancy is frivolous; it plays among the flowers of a meadow; it waters a garden or turns a little mill. Gathering strength in its youth, it becomes wild and impetuous. Impatient of the restraints which it still meets with in the hollows among the mountains, it is restless and fretful; quick in its turning, and unsteady in its course. Now it is a roaring cataract, tearing up and overturning whatever opposes its progress, and it shoots headlong down from a rock; then it becomes a sullen and gloomy pool, buried in the bottom of a glen. Recovering breath by repose, it again dashes along, till, tired of uproar and mischief, it quits all that it has swept along, and leaves the opening of the valley strewed with the rejected waste. Now, quitting its retirement, it comes abroad into the world, journeying with more prudence and discretion through cultivated fields, yielding to circumstances, and winding round what would trouble it to overwhelm or remove. It passes through the populous cities, and all the busy haunts of man, tendering its services on every side, and becomes the support and ornament of the country. Increased by numerous alliances, and advanced in its course, it becomes grave and stately

in its motions, loves peace and quiet; and in majestic silence rolls on its mighty waters till it is laid to rest in the vast abyss."

Rivers, which descend from primitive mountains into the secondary lands, often form *cascades* and *cataracts*. Such are the cataracts of the Nile, of the Ganges, and some other great rivers. The most picturesque falls are those of rapid rivers bordered by trees and precipitous rocks. Sometimes we see a body of water, before it arrives at the bottom, broken and dissipated into showers, like the Staubbach; sometimes it forms a watery arch, projected from a rampart of rock, under which the traveller may pass dry-shod, as the "falling spring" of Virginia; in one place, in a granitic district, we see it, as in the Rhine not far from its source, urge on its foaming billows amongst the pointed rocks; in another, amidst lands of calcareous formation, we see it, as in the Czettina, rolling down from terrace to terrace, and presenting sometimes a sheet and sometimes a wall of water. Some magnificent cascades have been formed, at least in part, by the hands of man; as the cascade of Velino, near Terni, which has been attributed to Pope Clement VIII. The elevation of cataracts has generally been exaggerated; one of the highest, that of Staubbach, instead of being 1100 as stated by some travellers, is only 900 feet according to trigonometrical measurement.

It is reckoned, that in the old continent there are about 430 rivers which fall *directly* into the sea; while in the new continent there are at least 145 of the same description. The largest river in Europe is the Wolga, which falls into the Caspian Sea, after having run a course of 2200 miles; the largest in Asia is the Kiang-ku in China, whose course is 3200 miles; the largest in Africa is the Nile, which is supposed to run 3000 miles; and the largest in America is the Amazon, which, after a course of nearly 4000 miles, falls into the Atlantic with a body of water 180 miles in breadth. It is calculated that the rivers of the globe supply the ocean with at least 13,630 cubical miles of water in a year; and that,

were the ocean completely drained of its waters, it would require *twenty-one thousand years* before its caverns could be again completely filled by them.

Lakes.—LAKES are accumulations of water surrounded on all sides by the land, and having no direct communication with the sea. They are divided into, 1. Such as neither receive nor give out rivers; 2. Such as give out rivers without receiving any; 3. Such as receive without giving out rivers; and 4. Such as both receive and give out rivers. Of the first kind, some are temporary, and depend on the fall of rain or the melting of snow for the supply of their waters; and others are perennial, and, receiving no supply of water from rivers, are supposed to derive it from springs at the bottom. Of the second description of lakes, the supply from springs is supposed to exceed the waste by evaporation, and the redundant quantity flows off by rivers. In the third kind of lakes, the water received by rivers must either be equal to the quantity carried off by evaporation, or the superabundant waters must have some subterraneous outlet. In such as receive and give out rivers, the quantity of water admitted, and what is carried off, are supposed nearly to balance each other. Some lakes or inland seas contain fresh water, and in others it is salt or brackish. Those which give rise to rivers, or are formed in the course of rivers, are fresh; but such as receive rivers, and have no visible outlet, contain salt water. Lake Ladoga, in Russia, one of the largest lakes in Europe, is 130 miles long and 75 miles broad, is full of shifting quicksands, and, like many other inland seas, is much exposed to storms. Baikal, in Siberia, is 366 miles in length, and 25 in breadth; it is remarkable for the transparency of its waters, and at certain seasons is also subject to dreadful storms. The Caspian Sea, which receives rivers, and has no visible outlet, is a collection of salt water. It is 750 miles long and 263 miles broad; numerous gulfs and islands are distributed along its eastern shore; in the middle it is said to be 500 fathoms deep; and,

being surrounded with very high land, it is also exposed to severe storms. The Caspian is 83 feet below the level of the Mediterranean. Lake Aral, to the eastward, is 150 miles long and 60 broad; is similar in its character to the Caspian; the water is salt; and extensive fisheries, particularly of the sturgeon and seal, are established on both lakes. But the lakes of the old world are far exceeded by the magnificent collections of fresh water in North America. Lake Superior, so called from being the largest on the continent, is 1500 miles in circumference, is supplied by more than 30 rivers, some of which are of considerable magnitude, and discharges its waters into Lake Huron, which is 1000 miles in circumference. Lake Huron communicates with Lake Michigan, which is also a large lake, and with Lake Erie, which is 231 miles in length and 70 in breadth; and between Lake Erie and Lake Ontario, which latter is 600 miles in circumference, are the celebrated falls of Niagara, where a large body of water is precipitated from 140 to 160 feet of perpendicular height.

THE TREASURES OF THE DEEP.

WHAT hid'st thou in thy treasure-caves and cells,
Thou hollow-sounding and mysterious Main?
—Pale glistening pearls, and rainbow-colour'd shells,
Bright things which gleam unreck'd of, and in vain.
—Keep, keep thy riches, melancholy Sea!
        We ask not such from thee.

Yet more, the Depths have more! What wealth untold
Far down, and shining through their stillness lies!
Thou hast the starry gems, the burning gold,
Won from ten thousand royal Argosies.
—Sweep o'er thy spoils, thou wild and wrathful Main!
        Earth claims not these again!

Yet more, the Depths have more! Thy waves have roll'd
Above the cities of a world gone by!

Sand hath fill'd up the palaces of old,
Sea-weed o'ergrown the halls of revelry!
—Dash o'er them, Ocean! in thy scornful play—
Man yields them to decay!

Yet more! the Billows and the Depths have more!
High hearts and brave are gather'd to thy breast!
They hear not now the booming waters roar,
The battle-thunders will not break their rest,
—Keep thy red gold and gems, thou stormy grave—
Give back the true and brave!

Give back the lost and lovely! those for whom
The place was kept at board and hearth so long,
The prayer went up through midnight's breathless gloom,
And the vain yearning woke 'midst festal song!
Hold fast thy buried isles, thy towers o'erthrown,—
But all is not thine own!

To thee the love of woman hath gone down,
Dark flow thy tides o'er manhood's noble head,
O'er youth's bright locks and beauty's flowery crown;
—Yet must thou hear a voice—Restore the Dead!
Earth shall reclaim her precious things from thee—
Restore the Dead, thou Sea!

Mrs Hemans.

THE CATARACT OF VELINO.

The roar of waters!—from the headlong height
Velino cleaves the wave-worn precipice:
The fall of waters! rapid as the light
The flashing mass foams shaking the abyss:
The hell of waters! where they howl and hiss,
And boil in endless torture; while the sweat
Of their great agony, wrung out from this
Their Phlegethon, curls round the rocks of jet
That gird the gulf around, in pitiless horror set,

And mounts in spray the skies, and thence again
Returns in an unceasing shower, which round,
With its unemptied cloud of gentle rain,
Is an eternal April to the ground,
Making it all one emerald:—how profound

The gulf! and how the giant element
From rock to rock leaps with delirious bound,
Crushing the cliffs, which, downward worn and rent
With his fierce footsteps, yield in chasms a fearful vent

To the broad column which rolls on, and shows
More like the fountain of an infant sea,
Torn from the womb of mountains by the throes
Of a new world, than only thus to be
Parent of rivers which flow gushingly,
With many windings, through the vale:—Look back!
Lo! where it comes like an eternity,
As if to sweep down all things in its track,
Charming the eye with dread,—a matchless cataract!

Horribly beautiful! but on the verge,
From side to side beneath the glittering morn,
An iris sits, amidst the infernal surge,
Like Hope upon a deathbed, and, unworn
Its steady dyes, while all around is torn
By the distracted waters, bears serene
Its brilliant hues, with all their beams unshorn:
Resembling, 'mid the torture of the scene,
Love watching Madness with unalterable mien.

BYRON.

DAILY REVOLUTION OF THE CELESTIAL SPHERE.

SUPPOSE yourself placed in the middle of a great plain, or on the top of a high mountain or tower, where nothing interrupts your view; the heavens will then appear like a great hemispherical vault above your head, supported by a circular plain, in the centre of which you are placed. The circle which forms the boundary between the heavens and the earth is called the *horizon;* the point directly over your head is called the *zenith;* and the distance from the horizon to the zenith is 90°, being the fourth part of the whole circle of the heavens, which is 360°. Only one-half of the heavens is visible; the other is below the horizon. You are not, therefore, to expect to see all the stars and constellations at once; but only

that half of them which, at the time of observation, is above the horizon.

Placed in the situation supposed, you may prepare to examine the face of the sky, after the light of day has disappeared, with a view to ascertain the *apparent* motions of the heavenly bodies. The hemispherical vault will appear studded with an immense number of luminous points or stars. Those that emit a twinkling light,—which constitute by far the most numerous class,—are called *fixed stars;* and those that emit a steady light,—of which only three or four are visible to the naked eye,—are called *planets.* If you continue your observations for some time, you will find, that, though the fixed stars preserve their distances from each other, they are continually changing their position with respect to the horizon. Some of them are rising in the east, and others setting in the west. All seem to describe circles in the heavens; and all appear to move from east to west. Some, like the sun in winter, rise far south, skim for a few hours the edge of the horizon, and then set. Others, like the sun in spring, rise in the east, traverse the middle of the sky, and set in the west; while others, like the sun at midsummer, rise considerably to the north of the east point, perform a larger circuit through the sky, and set in the north-west. A fourth class, like the sun in the arctic regions, move continually round in the heavens without setting. This last class are always found in the northern regions of the sky; and, by tracing carefully their different orbits, you will find, that the circles described by each star gradually become smaller and smaller, till at last you arrive at a star which seems to be at rest, and which appears to be the point (or near the point) around which they all move. This is called the pole-star, and nearly coincides with the point at which the axis of the earth would terminate were it produced to the heavens.*

* All this may be illustrated by a celestial globe, by merely turning it round from east to west, provided it is rectified for the latitude;

The planets also appear to move across the heavens every night, and consequently round the earth in a day; but there are many peculiarities in regard to their motions, which can only be discovered after a series of observations on successive evenings for a considerable period of time, and which need not be described in this stage of your knowledge. The same remarks apply to the moon, and also to the sun.

Now, what is the cause of this apparent diurnal revolution of all the celestial bodies? Do they actually revolve around the earth once every 24 hours, as they appear to do; or is their motion only apparent, the appearance being caused by the motion of the earth round itself in an opposite direction in the same period? Let us attempt to answer the question.

You have often, when in motion, had a momentary belief that objects which you knew to be stationary were moving, and you yourself at rest; for instance, in looking heedlessly out of the window of a carriage moving gently along the road, you have imagined that not the carriage but the trees and houses were moving. But you were in this case enabled instantly to undeceive yourself by comparing the objects apparently in motion with others known to be at rest. A case, however, may be imagined, where it would be impossible for you to determine which of two bodies was at rest and which in motion. Suppose yourself looking, in a dark night, from the cabin-window of a ship, upon a light apparently in motion,—it would be impossible for you, in this case, to determine which was the moving body. The change of place in the light might arise either from its being really in motion, as in the event of another ship passing by, while your ship was at anchor, or the light might be on shore, and the apparent motion occasioned by your ship swinging round its anchor, or proceeding on its voyage. But in your situation,

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for it is to be observed that the extent of circuit performed by any star, and the inclination of its circle to the horizon, depend upon the latitude of the place from which the observation is made.

having no intervening objects, whose place was known, with which to compare the light, you could come to no satisfactory conclusion as to the cause of its apparent change of place. Now, this is precisely the situation in which we stand with respect to the heavenly bodies. As far as appearances enable us to judge, it makes no difference whether the earth is at rest, and the heavens carried round it in 24 hours, or whether the heavens are at rest, and the earth carried round itself in the same time.

The question, therefore, resolves itself into this,—Which view of the matter is the more plausible, and attended with the fewest difficulties?

1. If we suppose the earth to revolve on its axis, the apparent daily revolution of the celestial sphere is effected by a motion comparatively moderate; whereas, if the whole heavens actually revolve, the motions necessary for accomplishing this must exceed all calculation. The earth's circumference, or the space through which every point of the equator must pass in 24 hours (supposing the rotation of the earth), measures 25,000 miles—which will produce a motion of 1000 miles per hour, or 500 yards per second,—a velocity nearly equal to that of a cannon-ball. This velocity undoubtedly is considerable; but it is totally insignificant when compared with the velocities required on the other supposition. The distance of the sun from the earth is about 95 millions of miles; if that luminary therefore revolves round the earth in 24 hours, he must move at the rate of nearly 25 millions of miles per hour, which is more than 20,000 times quicker than the motion of a cannon-ball. The planet Herschel is 20 times farther distant from us than the sun, and consequently the velocity of his daily motion must be 20 times greater. But these instances, though sufficiently startling, are nothing, when compared with the rapidity with which the fixed stars must move to accomplish a revolution in 24 hours. The distance of the nearest of these suns (for suns they are proved to be) is at least 20,000,000,000,000 miles,—a space which would require a motion considerably greater than a *thousand millions* of miles in a second, to enable a body to pass

over it in 24 hours. This certainly is a velocity far beyond what we are accustomed to conceive; and yet the velocity of the majority of the fixed stars must be infinitely greater than this. If you consider, therefore, the simplicity of the means employed, and the saving of labour effected by the rotation of the earth on its axis, instead of the revolution of the whole heavens, you cannot fail to conclude the former to be the true theory of the celestial motions.

2. This conclusion must appear still more obvious, if you attend to the bulks of these different bodies. Of the planets, three are found greatly to exceed the earth in size—Jupiter being nearly 1500 times, Saturn 900 times, and Herschel 80 times larger. The sun is considerably more than a million times the size of the earth; and each of the fixed stars is probably as large as the sun. Such being the magnitude of these bodies, how inconsistent is it with every idea of order, and with all our notions of infinite wisdom, to suppose that such immeasurable masses are daily revolving round our comparatively insignificant globe!—(*See Illustrations, Fig.* 16.)

But, 3. The most satisfactory proof of the earth's motion is derived from the form of the earth itself, and from certain variations in the force of gravity, observed at different parts of its surface. It is found that a clock goes considerably slower at the equator than towards the poles, and that it is necessary to shorten the pendulum $\frac{1}{6}$th of an inch to make the time correspond with that of London. How is this to be accounted for? It is not the heat of the climate, though this has the effect of lengthening metallic pendulums; for at Quito, which is covered with snow, the retardation of the clock is the same as at Cayenne. Nor is it the diminution of gravity at the equator, which necessarily causes the pendulum to move more slowly (as the pendulum is an index of the force of gravity;)* for, after allowance is made for this, there still

* The earth has been determined by actual measurement to be an oblate spheroid flattened towards the poles, and protuberant at the equator; and the force of gravity decreases as we pass from the poles to the equator, its action being always from the centre of the earth.

remains a considerable retardation to be accounted for. It is the rotation of the earth alone that affords a complete solution of the difficulty. By revolving on its axis it acquires what is called a centrifugal force, which has the effect of diminishing the force of gravity at its surface. But the degree of rotation may be such as entirely to destroy the force of gravity, and even to sweep the waters from the earth's surface, as we see the water fly off from a wet mop in twirling it round with the hand;—or the motion may be so slow as scarcely to prevent the waters from quitting the elevated land at the equator, and flowing towards the lower land at the poles. It is a subject of calculation, therefore, to determine what degree of rotation is necessary to keep the waters uniformly spread out over the whole surface, and, at the same time, to produce that degree of diminution in the action of gravity which is indicated by the retardation of the clock. Now the result of this calculation shows that a rotation of about 24 hours is precisely the degree of velocity requisite for producing these effects.

SECTION V.

JERUSALEM.

The modern city of Jerusalem may be roughly stated to be about a mile in length, and half a mile in breadth. Its population is estimated at 20,000, of which 5000 are Mussulmans, 5000 Christians, and 10,000 Jews. It stands at the south end of a large plain that extends northwards towards Samaria; but it immediately occupies two small hills, having valleys or ravines on the other three sides; which, to the east and the south, are very deep. That on the east is the valley of Jehosha-

phat; that on the south is called the valley of Siloam and (erroneously) of Gehinnom; that on the west, which is not so deep, the valley of Rephaim. On the east, Jerusalem is commanded by the Mount of Olives; on the south, by what the Christians absurdly denominate the Hill of Offence and the Hill of Evil Council; on the west, by a low rocky flat, called Mount Gihon, which rises towards the north to a commanding elevation; on the north-west, Scopo, where Titus encamped, is also higher ground than that on which Jerusalem stands: so that the Scripture representation of Jerusalem, as guarded by mountains, literally answers to its topographical situation:—"As the mountains are round about Jerusalem, so the Lord is round about his people, from henceforth, even for ever."—(*See Illustrations*, *Fig.* 17.)

"When seen," says Chateaubriand, "from the Mount of Olives, Jerusalem presents an inclined plane, descending from west to east. An embattled wall, fortified with towers and a Gothic castle, encompasses the city all round; excluding, however, part of Mount Sion, which it formerly enclosed. In the western quarter, and in the centre of the city, the houses stand very close; but in the eastern part, along the brook Kedron, you perceive vacant spaces; among the rest, that which surrounds the mosque erected on the ruins of the temple. The houses of Jerusalem are heavy square masses, very low, without chimneys or windows: they have flat terraces or domes on the top, and look like prisons or sepulchres. The whole would appear to the eye one uninterrupted level, did not the steeples of the churches, the minarets of the mosques, the summits of a few cypresses, and the clumps of nopals, break the uniformity of the plan. On beholding these stone buildings, encompassed by a stony country, you are ready to inquire if they are not the confused monuments of a cemetery in the midst of a desert.

"Enter the city, but nothing will you there find to make amends for the dulness of its exterior. You lose yourself among narrow, unpaved streets, here going up hill, there down, and you walk among clouds of dust or

loose stones. Canvass stretched from house to house increases the gloom of this labyrinth. A few paltry shops expose nothing but wretchedness to view, and even these are frequently shut, from apprehension of the passage of a cadi. Not a creature is to be seen in the streets, not a creature at the gates, except now and then a peasant gliding through the gloom, concealing under his garments the fruits of his labour, lest he should be robbed of his hard earnings by the rapacious soldier. Aside, in a corner, the Arab butcher is slaughtering some animal, suspended by the legs from a wall in ruins; from his haggard and ferocious look, and his bloody hands, you would suppose that he had been cutting the throat of a fellow-creature rather than killing a lamb. The only noise heard from time to time in the city is the galloping of the steed of the desert; it is the janissary who brings the head of the Bedouin, or who returns from plundering the unhappy Fellah."

The Jerusalem of sacred history is no more. Not a vestige remains of the capital of David and Solomon; not a monument of Jewish times is standing. The very course of the walls is changed, and the boundaries of the ancient city are become doubtful. The monks pretend to show the sites of the sacred places; but neither Calvary, nor the Holy Sepulchre, much less the Dolorous Way, the House of Caiaphas, &c., have the slightest pretensions to even a probable identity with the real places to which the tradition refers. A few gardens still remain on the sloping base of Mount Zion, watered from the pool of Siloam; the gardens of Gethsemane are still in a sort of ruined cultivation; the Mount of Olives still retains a languishing verdure, and nourishes a few of those trees from which it derives its name; but all round about Jerusalem the general aspect is blighted and barren; the grass is withered; the bare rock looks through the scanty sward; and the grain itself, like the staring progeny of famine, seems in doubt whether to come to maturity or die in the ear. The vine that was brought from Egypt is cut off from the midst of the land; the

vineyards are wasted; the hedges are taken away; and the graves of the ancient dead are open and tenantless.

To conceive of its ancient aspect, we must endeavour to shut our eyes to the domes, and minarets, and castellated towers, which now revolt every pleasing and sacred association; we must forget the Turks, the Arabs, and the monks, and blot out from the picture the holy sepulchre, with all the horrible mummery connected with it. We must imagine ourselves looking down from Mount Olivet on a well peopled and strongly fortified city, occupying the oblong area of two sloping hills, about four miles in circumference, and sheltered on almost every side by more commanding elevations, cultivated in terraces, and clothed to their very summits with the olive, the fig-tree, and the palm. The city itself, if it could not boast of a Parthenon, was probably equal, in architectural decoration, to any one then standing in the world. It could not, indeed, compare with Babylon, or Nineveh, or the hundred-gated metropolis of Egypt, either in extent or magnificence; but its two temples—the one built by Solomon, and the other repaired and completed by Herod—were successively the admiration of the world. Of the latter, Josephus has left us a description, which, making every allowance for his national partiality, must be held to prove that it was every way worthy of the founder of Cesarea and Sebaste, and the other cities which attest the greatness of the Jewish monarch. The stupendous foundations on which the terrace rested, at the height of 600 perpendicular feet from the valley, which was formed to extend the area of the temple, still remain to indicate the gigantic nature of the work. From the temple the city had the appearance of an amphitheatre, the slope of the hill being just sufficient to present it to the greatest advantage. At certain distances, towers of not less strength than architectural beauty broke the line of the walls; while, on the left, the acropolis of Zion overlooked the whole city. Modern Jerusalem, though now disfigured by intervals of waste ground and ruined heaps, still suggests the idea of "a

compact city;" but when every part was built upon, it must have peculiarly deserved this appellation. Its ancient populousness we read of with surprise; its gates received an influx of strangers from all parts; and the wealth thus poured into it rendered it probably one of the richest cities in the world. If to these topographical and political advantages we add the local sanctity which dignified the scene of so many proud historical recollections, and connect with the bulwarks, and palaces, and gardens of the metropolis of Judea, its consecrated character as the peculiar abode of Deity—the chosen mountain of Jehovah—the "city of God," we shall obtain some idea of the aspect which it once presented, when the light of heaven, which nowhere comes with a purer ray, shone on a free and favoured people, and the voice of joy and thanksgiving was heard ascending from the dwellings of her citizens.

CONDER—*Modern Traveller.*

JERUSALEM.

FALLEN is thy throne, O Israel!
  Silence is o'er thy plains!
Thy dwellings all lie desolate,
  Thy children weep in chains.
Where are the dews that fed thee
  On Etham's barren shore?
That fire from heaven that led thee
  Now lights that path no more!

Lord, thou didst love Jerusalem;
  Once she was all thine own:
Her love thy fairest heritage,
  Her power thy glory's throne,
Till evil came and blighted
  Thy long-loved olive-tree,
And Salem's shrines were lighted
  For other gods than thee.

Then sunk the star of Solyma,
  Then pass'd her glory's day,

Like heath that in the wilderness
  The light wind whirls away.
Silent and waste her bowers,
  Where once the mighty trod;
And sunk those guilty towers,
  Where Baal reign'd as God.

"Go," said the Lord, "ye conquerors,
  Steep in her blood your swords,
And raze to earth her battlements,
  For they are not the Lord's.
Tell Zion's mournful daughter
  O'er kindred bones she'll tread,
And Hinnom's vale of slaughter
  Shall hide but half her dead."

But soon shall other pictured scenes
  In brighter vision rise,
When Zion's sun shall sevenfold shine
  On all her mourners' eyes;
And on her mountains beauteous stand
  The messengers of peace;
"Salvation by the Lord's right hand!"
  They shout and never cease. MOORE.

MECHANICAL PROPERTIES OF AIR.

THE principal of the aeriform fluids is the air we breathe, which surrounds the earth, and forms the atmosphere. The most essential and important of its mechanical properties is its *spring* or *elasticity;* that is to say, its power of increasing or diminishing in bulk, according as it is more or less compressed. As there is no attraction of cohesion between its particles, the expansive power of heat has no adversary to contend with but gravity; any increase of temperature, therefore, expands it prodigiously, and a diminution proportionally condenses it.

Gravity or *weight* is the other remarkable mechanical property of air; and its gravity is much greater than you may at first imagine. It is true that the particles of which it is composed are infinitely small, and particles infinitely small must be separately very light; but, then,

reflect on the quantity of particles in the atmosphere. The atmosphere is thought to extend to about forty-five miles from the earth, and its gravity is such that a man of middling stature is computed to sustain, when the air is heaviest, the weight of about fifteen tons. This weight would be insupportable were it not for the equality of the pressure on every part of the body; but, when thus diffused, we can bear even a much greater weight, without any considerable inconvenience. In bathing, we support the pressure of the water in addition to that of the atmosphere; but, because this pressure is equally distributed over the body, we are scarcely sensible of it; whilst, if your shoulders, your head, or any particular part of your frame, were loaded with the additional weight of a hundred pounds, you would sink under the fatigue. Besides this, our bodies contain air, the spring of which counterbalances the weight of the external air, and renders us insensible to its pressure. The weight of the atmosphere, so far from being calculated to injure or incommode us, is in reality essential to our preservation; and if it were removed, the air within us, meeting with no external pressure to restrain its elasticity, would distend our bodies, burst the vessels that confine it, and put a period to our existence.

The actual weight of air has been determined by experiment. A column of air reaching to the top of the atmosphere, whose base is a square inch, weighs 15 lbs. when the air is heaviest; every square inch of our bodies, therefore, sustains a weight of 15 lbs., and the total weight of the atmosphere may be known by multiplying the number of square inches that there are on the surface of the globe by 15. It amounts to about 5,000,000,000,000,000 tons. The instrument called a *barometer*, which is used to indicate the state of the weather, shows the weight of the atmosphere: its construction is extremely simple. You first fill a glass tube, about three feet in length and open only at one end, with mercury; then, stopping the open end with your

finger, you immerse it in a cup containing a little of the same fluid. Instead of all the mercury which is in the tube running down into the cup, as the law of the equilibrium of fluids would lead you to expect, you will find that only part of it does so, while the remainder remains in the tube, leaving a vacant space in the upper part of the tube. The explanation of this phenomenon is this:—The space in the upper part of the tube which the mercury has left, is necessarily a perfect vacuum; and therefore the mercury in the tube is relieved from the pressure of the atmosphere, whilst that in the cup remains exposed to it. The pressure of the air on the mercury in the cup supports the mercury in the tube, and prevents it from falling. In other words, the column of mercury balances the column of atmospheric air, and the equilibrium of the mercury is destroyed only to preserve the general equilibrium of fluids. This simple apparatus is all that is essential to a barometer: the tube, and the cup or vase, are fixed on a board for the convenience of suspending it: the board is graduated for the purpose of ascertaining the height at which the mercury stands in the tube; and a small movable metal plate is attached to show that height with greater accuracy. The mercury is in general sustained at the height of about 29 inches: but this height varies according to the weight of the atmosphere, which varies according to the state of the weather. The height is greatest in dry weather, when the pressure of the atmosphere is the greatest; and least in wet weather, when the pressure is the least.—(*See Illustrations*, *Fig.* 18.)

The pressure of the atmosphere explains a variety of common phenomena. When we take a draught of water out of a basin, or a running stream, we immerse our mouths in the water, and by the effort which we make to draw in the water a partial vacuum is formed in the mouth; the water then rises into it by the pressure of the atmosphere upon the surface of the external water. The same cause explains the action of a boy's sucker in lifting large stones—the rise of water in pumps—the effects produced by *cements*—the firm adhesion of snails

and periwinkles to rocks and stones—and the fact, that a cask will not run by the cock, unless a hole be opened in some other part of the cask.

THE OLD PHILOSOPHER AND THE YOUNG LADY.

"ALAS!" exclaimed a silver-headed sage, "how narrow is the utmost extent of human knowledge! I have spent my life in acquiring knowledge, but how little do I know! The farther I attempt to penetrate the secrets of nature, the more I am bewildered and benighted. Beyond a certain limit all is but conjecture: so that the advantage of the learned over the ignorant consists greatly in having ascertained how little is to be known.

"It is true that I can measure the sun, and compute the distances of the planets; I can calculate their periodical movements, and even ascertain the laws by which they perform their sublime revolutions; but with regard to their construction, to the beings that inhabit them, their condition and circumstances, what do I know more than the clown?—Delighting to examine the economy of nature in our own world, I have analyzed the elements, and given names to their component parts. And yet, should I not be as much at a loss to explain the burning of fire, or to account for the liquid quality of water, as the vulgar, who use and enjoy them without thought or examination?—I remark, that all bodies, unsupported, fall to the ground, and I am taught to account for this by the law of gravitation. But what have I gained here more than a term? Does it convey to my mind any idea of the nature of that mysterious and invisible chain which draws all things to a common centre?—Pursuing the track of the naturalist, I have learned to distinguish the animal, the vegetable, and the mineral kingdoms, and to divide these into their distinct tribes and families;—but can I tell, after all this toil, whence a single blade of grass derives its vitality? Could the most minute researches enable me to discover the exquisite pencil that paints the flower of the field? and have I ever detected

the secret that gives their brilliant dye to the ruby and the emerald, or the art that enamels the delicate shell?—I observe the sagacity of animals—I call it instinct, and speculate upon its various degrees of approximation to the reason of man; but, after all, I know as little of the cogitations of the brute as he does of mine. When I see a flight of birds overhead, performing their evolutions, or steering their course to some distant settlement, their signals and cries are as unintelligible to me as are the learned languages to an unlettered mechanic: I understand as little of their policy and laws as they do of Blackstone's Commentaries.

"Alas! then, what have I gained by my laborious researches but an humbling conviction of my weakness and ignorance! Of how little has man, at his best estate, to boast! What folly in him to glory in his contracted powers, or to value himself upon his imperfect acquisitions!"

"Well!" exclaimed a young lady, just returned from school, "my education is at last finished: indeed, it would be strange if, after five years' hard application, anything were left incomplete. Happily, it is all over now, and I have nothing to do but exercise my various accomplishments.

"Let me see!—as to French, I am mistress of that, and speak it, if possible, with more fluency than English. Italian I can read with ease, and pronounce very well, as well at least, and better, than any of my friends; and that is all one need wish for in Italian. Music I have learned till I am perfectly sick of it. But, now that we have a grand piano, it will be delightful to play when we have company. And then there are my Italian songs, which everybody allows I sing with taste, and as it is what so few people can pretend to, I am particularly glad that I can. My drawings are universally admired, especially the shells and flowers, which are beautiful, certainly: besides this, I have a decided taste in all kinds of fancy ornaments. And then, my dancing and waltzing,

in which our master himself owned that he could take me no farther;—just the figure for it, certainly! it would be unpardonable if I did not excel. As to common things, geography, and history, and poetry, and philosophy, thank my stars, I have got through them all! so that I may consider myself not only perfectly accomplished, but also thoroughly well informed.

"Well, to be sure, how much I have fagged through; the only wonder is that one head can contain it all!"

JANE TAYLOR.

THE KNIGHT OF ARTS AND INDUSTRY.

AMID the greenwood shade this boy was bred,
And grew at last a knight of muchel fame,
Of active mind and vigorous lustyhed,
The Knight of Arts and Industry by name.
Earth was his bed, and boughs his roof did frame;
He knew no beverage but the flowing stream;
His tasteful well-earn'd food the sylvan game,
Or the brown fruit with which the woodlands teem:
The same to him glad summer, or the winter breme.

Him did Minerva rear and nurture well,
In every science and in every art,
By which mankind the thoughtless brutes excel,
That can or use, or joy, or grace impart,
Disclosing all the powers of head and heart:
Ne were the goodly exercises spared
That brace the nerves, or make the limbs alert,
And mix elastic force with firmness hard:
Was never knight on ground mote be with him compared.

Sometimes, with early morn, he mounted gay
The hunter-steed, exulting o'er the dale,
And drew the roseate breath of orient day;
Sometimes, retiring to the secret vale,
Yclad in steel, and bright with burnish'd mail,
He strain'd the bow, or toss'd the sounding spear,
Or, darting on the goal, outstripp'd the gale,
Or wheel'd the chariot in its mid-career,
Or strenuous wrestled hard with many a tough compeer.

At other times he pried through Nature's store,
Whate'er she in the ethereal round contains,
Whate'er she hides beneath her verdant floor,
The vegetable and the mineral reigns;
Or else he scann'd the globe, those small domains,
Where restless mortals such a turmoil keep,
Its seas, its floods, its mountains, and its plains;
But more, he search'd the mind, and roused from sleep
Those moral seeds whence we heroic actions reap.

Nor would he scorn to stoop from high pursuits
Of heavenly truth, and practise what she taught.
Vain is the tree of knowledge without fruits.
Sometimes in hand the spade or plough he caught,
Forth calling all with which boon earth is fraught;
Sometimes he plied the strong mechanic tool,
Or rear'd the fabric from the finest draught;
And oft he put himself to Neptune's school,
Fighting with winds and waves on the vext ocean-pool.

To solace then these rougher toils, he tried
To touch the kindling canvass into life;
With nature his creating pencil vied,
With nature, joyous at the mimic strife;
Or, to such shapes as graced Pygmalion's wife,
He hew'd the marble; or, with varied fire,
He roused the trumpet and the martial fife,
Or bade the lute sweet tenderness inspire,
Or verses framed that well might wake Apollo's lyre.

Accomplish'd thus he from the woods issued,
Full of great aims, and bent on bold emprize;
The work which long he in his breast had brew'd,
Now to perform he ardent did devise;
To-wit, a barbarous world to civilize.
Earth was till then a boundless forest wild:
Nought to be seen but savage woods and skies;
No cities nourish'd arts, no culture smiled,
No government, no laws, no gentle manners mild.

A rugged wight, the worst of brutes, was man:
On his own wretched kind he ruthless prey'd:
The strongest still the weakest overran;
In every country mighty robbers sway'd,
And guile and ruffian-force were all their trade.

Life was a scene of rapine, want, and woe;
Which this brave knight, in noble anger, made
To swear he would the rascal rout o'erthrow,
For, by the powers divine, it should no more be so!

THOMSON.

THIRTY YEARS AGO.*

Thirty years ago there were many hundred millions of human beings alive who are now dead. It requires not the aid of inspiration to foretell the same catastrophe, respecting hundreds of millions now living, in thirty years to come.

Thirty years ago the slave-trade was a lawful, honourable, humane, and Christian occupation. It is now piracy, and persons engaged in it are liable to be "hanged by the neck until dead" at the yard-arm. Human laws are ever varying—justice is eternal. Slavery itself is *now* as lawful, honourable, and Christian a thing as the slave-trade was then; but there are some signs of the times which afford a hope that, by a natural demise, a legal execution, or actual suicide, our colonies will be rid of this curse in thirty years to come.

Thirty years ago Bonaparte was not known, except as an artillery-officer in the French army. His campaigns in Italy, Germany, Egypt, Syria, Poland, and Russia, his chief consulship, his imperial dignity, his abdication, his exile in Elba, his return to Paris, his overthrow at Waterloo, his imprisonment at St Helena, and his death, have all been and gone, and are as if they had never been, except in their consequences, which will not cease to be implicated with the fate of nations till the world's end. There may be a boy at school this day who shall arrive at equal eminence of power, glory, and dominion over the destinies of man, through life and beyond the grave, in thirty years to come.

Thirty years ago the small-pox was a perpetual pestilence, walking in darkness throughout the world wherever ships and armies, merchants or travellers, from Europe

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* Written about the year 1820.

had visited. Vaccination has chased this fiend "from the rising of the sun to the going down of the same;" and, from the shores of Greenland to Patagonia, there will scarcely be a pock-marked face to be seen in thirty years to come.

Thirty years ago there was scarcely a poet living among us except Cowper and Peter Pindar. There are now as many authors of volumes of verse as days in the year,—ay, even in leap year,—we had almost said hours. The works of thirty of these may perhaps be remembered for thirty years to come.

Thirty years ago there were neither gas-lights, nor steam-packets, nor safety-lamps, nor life-boats, nor a hundred other useful mechanical and philosophical inventions. All these will most probably be improved beyond what can be anticipated in thirty years to come.

Thirty years ago there were neither Bible, nor Missionary, nor Tract, nor School Societies, for the instruction and conversion of the heathen at home and abroad in the only true religion, of all that bear that desecrated name under heaven. There are now about fifty parent institutions of the kind, whose progeny of auxiliaries at least reach a thousand, and whose income amounts to nearly half a million sterling. It is not unreasonable to expect that these may be increased tenfold, at the least computation, during thirty years to come. MONTGOMERY.

THE VOICE OF SPRING.

I COME, I come! ye have call'd me long,
I come o'er the mountains with light and song;
Ye may trace my step o'er the wakening earth,
By the winds which tell of the violet's birth,
By the primrose stars in the shadowy grass,
By the green leaves opening as I pass.

I have breathed on the South, and the chestnut-flowers
By thousands have burst from the forest-bowers
And the ancient graves, and the fallen fanes,
Are veil'd with wreaths on Italian plains.

—But it is not for me, in my hour of bloom,
To speak of the ruin or the tomb!

I have pass'd o'er the hills of the stormy North,
And the larch has hung all his tassels forth,
The fisher is out on the sunny sea,
And the rein-deer bounds through the pasture free,
And the pine has a fringe of softer green,
And the moss looks bright where my step has been.

I have sent through the wood-paths a gentle sigh,
And call'd out each voice of the deep-blue sky,
From the night-bird's lay through the starry time,
In the groves of the soft Hesperian clime,
To the swan's wild note by the Iceland lakes,
When the dark fir-bough into verdure breaks.

From the streams and founts I have loosed the chain;
They are sweeping on to the silvery main,
They are flashing down from the mountain-brows,
They are flinging spray on the forest-boughs,
They are bursting fresh from their sparry caves,
And the earth resounds with the joy of waves.

Come forth, O ye children of gladness, come!
Where the violets lie may now be your home.
Ye of the rose-cheek and dew-bright eye,
And the bounding footstep, to meet me fly,
With the lyre, and the wreath, and the joyous lay,
Come forth to the sunshine, I may not stay.

Away from the dwellings of care-worn men,
The waters are sparkling in wood and glen;
Away from the chamber and dusky hearth,
The young leaves are dancing in breezy mirth;
Their light stems thrill to the wild-wood strains,
And Youth is abroad in my green domains.

Mrs Hemans.

PROPHECY.

Man is endowed with faculties which enable him not only to recollect the past, but also, within certain limits, to anticipate the future. Encouraged to expect a con-

tinuance of the course of nature, and of regularity in the order of causes and effects, his reminiscences of the past aid his calculations of the future; and his sagacity, guided by experience, aspires, in many instances, to the character of foresight. Many physical events, such as eclipses, the changes of the seasons, the results of certain combinations of machinery, and the like, he can thus predict with infallible certainty; and even in regard to the future effects of moral causes, he can frequently speak with perfect confidence.

But *Prophecy*, in the enlarged sense of the word, as relating to events and circumstances altogether beyond the range of human calculation and experience, can belong only to prescience,—an attribute of that mind which is at once omniscient and omnipotent. To him only who formed all creatures, and who controls all events, is the future as distinctly known as the past,—is the book of decrees as open as the book of remembrance. He only can disclose the train of future events;—and if any book therefore exists, which contains a series of such disclosures, such a book must necessarily have proceeded from his inspiration and authority.

Such a book the Bible professes to be! and it is our duty to examine and decide upon its claims. Have we satisfactory evidence, then, that its predictions were recorded and promulgated before the events which they describe? Is there an obvious and palpable accordance between the predictions and the events? Are the events of such a nature, that, when the prophecies were promulged, it was impossible for human sagacity to have foreseen their occurrence? If these three questions can be answered in the affirmative in reference to the predictions in question, we are furnished with an insuperable argument for the inspiration and divine authority of the Bible. Now, these questions can be answered in the affirmative.

There are numerous prophecies in the Old Testament of which the accomplishment is recorded in the New. Of this kind are those which relate to the Mes-

siah. In the writings of David and Isaiah, we have a series of predictions, which foretell, in the most definite terms, the following circumstances:—That the Messiah was to be a descendant of David,—that he was to be the son of a virgin,—that he was to be a native of Bethlehem,—that he was to be a resident in Galilee,—that he was to be destitute of external recommendations to public notice,—that he was to pass through a life of suffering,—that he was to be betrayed by a familiar friend,—that he was to be proceeded against as a culprit,—that he was to display consummate meekness and patience,—that he was to be cut off by a violent death, yet with the forms of justice,—that his apparel was to be parcelled out among his executioners,—that, although classed among malefactors, he was to be interred in a rich man's tomb,—that he was to rise again from the dead without undergoing the process of corruption,—and that he was to leave this world and ascend up into heaven.——Now, to these predictions apply the three tests which have been mentioned. Were these prophecies written and published previously to the events?—Let the Jews, the adversaries of Christianity, answer! These prophecies are in their Bibles as well as in ours; and it is a well-authenticated fact, that they were extant, not only in the original Hebrew, but also in a Greek translation, long before the era of the Gospel history. Is there an obvious and palpable accordance between these predictions and the record of the occurrences? Compare the passages in the Psalms and in Isaiah with the history of the events as given by the Evangelists, and you will be fully satisfied of the precise, the minute, and the multiplied coincidences between the one and the other.——And is not the third criterion equally applicable? Is it conceivable, that circumstances so complicated, so unparalleled, so far removed from the range of human conjecture, could, by any possibility, have been foreseen even by the most sagacious of our race?—Can the predictions, then, be accounted for in any other way than by tracing them to divine prescience? or can the books which contain them

have been dictated by any other authority but the authority of Heaven?

There are many prophecies in both the Old and New Testament, of which the accomplishment is recorded in profane history. Such, for example, are Daniel's astonishing predictions respecting the four successive monarchies, which, for a course of ages, were to give laws to the most civilized nations of the earth. Such also are the explicit predictions respecting Egypt, and Tyre, and Nineveh, and Babylon, and Ishmael; and such are the prophecies in regard to the destruction of Jerusalem, and the final dispersion of the Jews;—all of which have been so signally fulfilled. To all these, it must be evident, the tests already mentioned are strictly applicable.

A third class of Scripture-prophecies relate to events which are still in the course of fulfilment. They regard principally the progressive diffusion of Christianity through the Gentile world, and they are to be found in almost every book of the Bible from Genesis to Revelation. To such predictions the second test is only partially applicable, but the first and third apply in all their latitude. Nothing short of Divine prescience could have foretold even such a propagation of Christianity as that which has already taken place. Think of the state of the world, we say not in the days of Abraham, who first made the prediction, or of David, or of Isaiah, or even our Lord, who successively repeated it, but think of it in the days of the Apostles. Think of the exclusive nature of the Jewish religion, of the supercilious contempt with which they regarded all other nations, and the thorough dislike with which all other nations regarded them.—Think of the qualifications of the first propagators of the Gospel, and of the opposition with which they had to contend both from Jews and Gentiles,—and say, whether human sagacity could have foreseen the triumphs of Christianity? and whether predictions so clear, so strong, so numerous, so coincident with the facts now recorded in the history of the Christian Church, must not necessarily have had an origin in the prescience which is divine?

There is a fourth class of Scripture-prophecies,—those which are still unfulfilled,—but these, of course, cannot *at present* be adduced as evidences of the inspiration and divine authority of the Bible. In the course of ages, however, they will doubtless be employed for this purpose; and, in the mean time, they ought to command our implicit belief, as forming a part of that record which is proved, by the *fulfilled* predictions which it contains, to be a revelation from Heaven.

THE DAY OF JUDGMENT.

THE Lord shall come! the earth shall quake;
The mountains to their centre shake;
And, withering from the vault of night,
The stars shall pale their feeble light—
The Lord shall come! but not the same
As once in lowliness he came,—
A silent Lamb before his foes,
A weary man, and full of woes,
The Lord shall come! a dreadful form,
With rainbow-wreath, and robes of storm;
On cherub-wings, and wings of wind,
Appointed Judge of all mankind.
Can this be He, who wont to stray
A pilgrim on the world's highway,
Oppress'd by power, and mock'd by pride,
The Nazarene,—the Crucified?
While sinners in despair shall call,
"Rocks, hide us; mountains, on us fall!"
The saints, ascending from the tomb,
Shall joyful sing, "The Lord is come!"

HEBER.

THE hundred-gated Cities then,
The Towers and Temples, named of men
Eternal, and the Thrones of Kings;
The gilded summer Palaces,
The courtly bowers of love and ease,
Where still the Bird of pleasure sings:

Ask ye the destiny of them?
Go, gaze on fallen Jerusalem!
Yea, mightier names are in the fatal roll,
'Gainst earth and heaven God's standard is unfurl'd,
The skies are shrivell'd like a burning scroll,
And one vast common doom ensepulchres the world!

MILMAN.

STAND the Omnipotent decree,
Jehovah's will be done!
Nature's end we wait to see,
And hear her final groan!
Let this earth dissolve and blend
In death the wicked and the just:
Let those ponderous orbs descend,
And grind us into dust!

Rests secure the righteous man,
At his Redeemer's beck,
Sure to emerge and rise again,
And mount above the wreck:
Lo! the heavenly spirit towers,
Like flames o'er Nature's funeral pyre:
Triumphs in immortal powers,
And claps his wings of fire!

Nothing hath the just to lose,
By worlds on worlds destroy'd;
Far beneath his feet he views,
With smiles the flaming void;
Sees this universe renew'd,
The grand millennial reign begun;
Shouts with all the sons of God
Around the Eternal throne!

C. WESLEY.

COMPOUND BODIES—AIR, WATER.

COMPOUND bodies are innumerable; but none are more important than the two I shall now describe to you,—*air* and *water*.

The term atmosphere is applied to that mass of gase-

ous matter which everywhere surrounds the earth, which is preserved at the surface of the earth by the force of gravity, and which revolves together with it around the sun. Air was one of the four elements of the ancients; but modern chemistry has demonstrated it to be a compound body. There is now no doubt that it is composed of oxygen and nitrogen, and that 100 measures of pure atmospheric air consist of 20 volumes of oxygen and 80 of nitrogen. This, however, it must be recollected, is the constitution of pure atmospheric air. The atmosphere itself is never absolutely pure; it always contains a certain variable quantity of carbonic acid and watery vapour, besides the odoriferous matter of flowers and other volatile substances. But carbonic acid never exceeds 1 in 100 parts, and generally amounts only to 1-1000th or 1-2000th of the whole.—The chief chemical properties of the atmosphere are owing to the presence of oxygen gas. Air, from which this principle has been withdrawn, can no longer support respiration* and combustion; and metals are not oxydized by being heated in it. Most of the spontaneous changes which mineral and dead organized matters undergo are owing to the powerful affinities of oxygen. But, whilst oxygen is essential to the life of animals, it does not appear that the healthiness of the air, at different times and in different places, depends on

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* The necessity of oxygen to the support of life was strikingly exemplified in the fate of the unhappy men who died in the *black-hole* of Calcutta. On the 20th of June 1756, about eight o'clock in the evening, 146 men were forced, at the point of the bayonet, into a dungeon only 18 feet square. They had been but a few minutes confined in this infernal prison, before every one fell into a perspiration so profuse, that no idea can be formed of it. This brought on a raging thirst, the most difficult respiration, and an outrageous delirium. Such was the horror of their situation, that every insult that could be devised against the guard without, and all the opprobrious names that the viceroy and his officers could be loaded with, were repeated, to provoke the guard to fire upon them, and terminate their sufferings. Before 11 o'clock the same evening one-third of the men were dead; and before 6 next morning only 23 came out alive, but most of them in a high putrid fever.

the relative quantity of this gas. It appears, on the contrary, that the composition of the air is not only constant in the same place, but is the same in all regions of the earth, and at all altitudes. Air collected at the summit of the highest mountains contains the same proportion of oxygen as that of the lowest valleys. The air of Egypt is the same as that of France. Even the miasmata of marshes, and the effluvia of infected places, owe their noxious qualities to some principle of too subtile a nature to be detected by chemical means, and not to any deficiency of oxygen.

Since oxygen is necessary to combustion, to the respiration of animals, and to various other natural operations, by all of which that gas is withdrawn from the air, it is obvious that its quantity would gradually diminish unless the tendency of those causes was counteracted by some compensating process. To all appearance there does exist some source of compensation. The only source, however, by which it is known to be supplied is by the action of growing vegetables. A healthy plant absorbs carbonic acid during the day, appropriates the carbonaceous part of that gas to its own wants, and evolves the oxygen with which it was combined. During the night, indeed, an opposite effect is produced. Oxygen gas then disappears, and carbonic acid is eliminated; but there is reason to believe that plants during 24 hours yield more oxygen than they consume.

Water is found by chemists to be composed of oxygen and hydrogen. Its constitution, by weight, is 8 of the former and 1 of the latter, and by measure, 1 of the former and 2 of the latter. It is one of the most powerful chemical agents we possess; and its agency is owing partly to the extensive range of its own affinity, and partly to the nature of its constituent parts. It combines directly with many bodies; sometimes in a variable ratio, as in ordinary solution, sometimes in a fixed definite proportion, as is exemplified by its union with several of the acids, the alkalies, and all salts that contain water of crystallization.

The purest water that can be found as a natural product is procured by melting freshly-fallen snow, or by receiving rain in clean vessels at a distance from houses. But this water is not absolutely pure; for, if placed under the exhausted receiver of an air-pump, bubbles of gas escape from it, which gas is much richer in oxygen than atmospheric air. All water which has once fallen on the ground becomes impregnated with more or less earthy or saline matters, and can be separated from them only by distillation. The distilled water thus obtained is absolutely pure.

There is a peculiarity in the effect of caloric upon water which deserves particular notice. The general law in regard to caloric is, that when it is added to bodies they expand, and when it is withdrawn from them they contract. But this law holds true of water only within certain limits. Ice, as every one knows, swims upon the surface of water, and therefore must be lighter than it, which is a convincing proof that water, at the moment of freezing, must expand. The increase is estimated at about $\frac{1}{10}$th of its volume. The most remarkable circumstance attending this expansion is the prodigious force with which it is effected. Mr Boyle filled a brass tube, three inches in diameter, with water, and confined it by means of a movable plug; the expansion, when it froze, took place with such violence as to push out the plug, though preserved in its situation by a weight equal to 74 pounds. This accounts for the bursting of pipes, the disruption of mounds of earth, &c., which often accompany severe frosts. But it is not merely during the act of congelation that water expands, for it begins to dilate considerably before it actually freezes. From decisive experiments made by Dr Hope, it appears that water obeys the usual law till it has cooled to the temperature of 40° F., after which the abstraction of caloric produces an increase instead of a diminution of volume.

The cause of the expansion of water at the moment of freezing is attributed to a new and peculiar arrangement of its particles. Ice is in reality crystallized water, and

during its formation the particles arrange themselves in ranks and lines, which cross each other, and consequently occupy more space than when they were in a liquid state. No very satisfactory reason can be assigned for the expansion which takes place previous to congelation. But it is supposed that the water begins to arrange itself in the order it will assume in the solid state before actually laying aside the liquid form. But whatever be the chemical cause of the expansion of water under reduction of temperature, the *final cause* is obvious. Had the case been otherwise, had water, when deprived of a portion of its caloric, become specifically heavier than it was before, the present constitution of nature would have been materially deranged, and many of our present comforts, nay, our very existence, would have been endangered. At whatever time the temperature of the atmosphere became reduced to the freezing-point, the water on the surface of our rivers and lakes would have been converted into a layer of ice; this layer would have sunk to the bottom as it froze; another layer of ice would have been immediately produced, which would have sunk to the former layer, and so on, in succession, till, in the course of time, all our rivers, from the surface to the bottom, and every other portion of water capable of being frozen, would have been converted into solid masses of ice, which all the heat of summer could never have melted. We should have been deprived of most of the advantages we now derive from the liquid element, and in a short time the face of nature would have been transformed into a frozen chaos. But in the existing constitution of things, all such dismal effects are prevented in consequence of the Creator having subjected the waters to a law contrary to that of most other fluids, by means of which the frozen water swims upon the surface, and prevents the cold from penetrating to any great depth in the subjacent fluid. How admirably then does this *exception* to the general law of nature display the infinite intelligence of the Great Contriver of all things, and his providential care for the comfort of his creatures!

GRAVES OF THE POOR.

PERHAPS in this neglected spot is laid
  Some heart once pregnant with celestial fire;
Hands that the rod of empire might have sway'd,
  Or waked to ecstasy the living lyre:

But Knowledge to their eyes her ample page,
  Rich with the spoils of time, did ne'er unroll:
Chill Penury repress'd their noble rage,
  And froze the genial current of the soul.

Full many a gem of purest ray serene
  The dark unfathom'd caves of ocean bear;
Full many a flower is born to blush unseen,
  And waste its sweetness on the desert air.

Some village Hampden, that, with dauntless breast,
  The little tyrant of his fields withstood;
Some mute inglorious Milton here may rest;
  Some Cromwell, guiltless of his country's blood.

The applause of listening senates to command,
  The threats of pain and ruin to despise,
To scatter plenty o'er a smiling land,
  And read their history in a nation's eyes,

Their lot forbade: nor circumscribed alone
  Their growing virtues, but their crimes confined;
Forbade to wade through slaughter to a throne,
  And shut the gates of mercy on mankind;

The struggling pangs of conscious truth to hide;
  To quench the blushes of ingenuous shame;
Or heap the shrine of luxury and pride
  With incense kindled at the muse's flame.

Far from the madding crowd's ignoble strife,
  Their sober wishes never learn'd to stray;
Along the cool sequester'd vale of life
  They kept the noiseless tenor of their way.

Yet even these bones from insult to protect,
  Some frail memorial still erected nigh,
With uncouth rhymes and shapeless sculpture deck'd
  Implores the passing tribute of a sigh.

For who, to dumb forgetfulness a prey,
  This pleasing anxious being e'er resign'd,
Left the warm precincts of the cheerful day,
  Nor cast one longing, lingering look behind? GRAY.

WHAT A CHANGE!

WHAT was the condition of our country in the time of the Romans? Look back and consider;—see its ancient tribes, brave indeed, but savage—fishing in its waters, or hunting upon its mountains—their bodies painted in all the fantastic colours of barbarism—their minds still more disfigured with the stains of cruelty, impurity, and falsehood—the slaves of druidical idolatry—bending the knee to some demon—holding their wives as the slaves of their caprice and tyranny—and sacrificing the children whom God had given them at the shrine of the devil!—What is our country now? Its inhabitants are settled into civilized and domestic life—the sciences cultivated—the arts advancing—industry, notwithstanding occasional stagnation, all astir—the fields waving with heavy corn—the most ingenious manufactures produced—the human intellect acknowledging but one God, all-gracious and mighty—tyranny over the female sex abolished—and the cruel immolation of children altogether unknown!

How has this wonderful change been produced? By the revelation of Jesus Christ. Human society will no doubt of itself make some progress towards civilisation; but civilisation without Christianity is barbarism. Is China civilized, with her infants exposed to the dogs or to the vultures? Is Hindostan civilized, with her widows self-immolated with the bodies of their deceased husbands, or her aged inhabitants exposed alive by their own children on the banks of the Ganges? Are Mohammedan countries civilized, with their females kept in almost constant confinement, and made the subjects of the most intolerable oppression? In none of the countries where a false religion prevails can you ever find the human mind in that healthful condition which is necessary to the per-

formance of anything that is truly great or noble. Even the much-extolled nations of antiquity, although they exhibited the grandeur of intellect, did not exhibit the grandeur of morals; and it is the union of the two which alone can elevate man to that dignified station which his nature was intended to occupy. It is the gospel of Jesus Christ which has softened the human heart, saving infants, and widows, and parents from premature death, and the female sex from bondage. It is the gospel which, emancipating man from the slavery of false religion, and thus communicating a right direction to his moral and intellectual energies, has become the parent of ingenuity, industry, learning, and happiness. Search the annals of the nations of antiquity, or of any country to which the gospel is a stranger,—where, amongst them, do you find any provision for the poor, any asylum for the destitute, any lazar-house for the sick, any refuge for the penitent profligate? But see these monuments of the spirit of the Christian religion scattered *throughout* our land—these trophies of her victory over the selfishness, or thoughtlessness, or cruelty of human nature! Were an ancient Greek or Roman, wrapping himself up in his scattered ashes, to rise from the dead, and to demand a proof of the blessings shed on Britain by the gospel, I would point to our hospitals, to our infirmaries, to our penitentiaries; I would lead him to inspect our societies for clothing the naked, for visiting the destitute, for relieving the poor; and I would ask him, without fear of an answer in the affirmative, if such things were known in the cities of antiquity—in republican Athens, in imperial Rome? The mountains of our country show their features as rough as they did two thousand years ago—its torrents foam down their rocky beds with the same violence as ever—the ocean around us, hoary with storms, precipitates itself upon our shores with equal violence as in the days of Druidism. But how changed are the inhabitants of that country! Barbarism and cruelty have, like the snow before the sun, disappeared before the beams of Chris-

tianity; the moral world has assumed a mild and genial aspect, the efflorescence of Christian virtue has burst out upon it; and the ancient song has been verified,—"The winter is past, the rain is over and gone, the flowers appear on the earth, the time of the singing of birds is come, and the voice of the turtle is heard in our land."

Leisure Hours.

CHRISTIAN MISSIONS.

WHEN wilt thou arise and reign,
Lord of angels, King of men,
Gird thy sword upon thy thigh,
And lift thy banner, thou Most High!
Heathen cities only wait
Thy bidding, to throw wide each gate;
Heathen temples only stay
Thy beck, to bid their gods away.

Trumpet-tongues, that wont to vaunt
Of idols dumb, thy word but want,
Jesus' matchless name to shout
All the wondering world throughout.
Speak,—and o'er each heathen isle
Bethlehem's star-beams sweetly smile!
Speak,—and by each heathen tongue
Bethlehem's angel-hymn is sung!

And 'tis done:—already see
Myriads shout thy victory;
Kings of Ind already greet
With costliest gems thy welcome feet,
Thou hast conquer'd, thou hast slain!
Lord of angels, King of men!
Girt thy sword upon thy thigh,
And waved thy cross triumphantly! *Original.*

FROM Greenland's icy mountains,
From India's coral strand,
Where Afric's sunny fountains
Roll down their golden sand;

From many an ancient river,
  From many a palmy plain,—
They call us to deliver
  Their land from error's chain.

Shall we, whose souls are lighted
  With wisdom from on high,
Shall we to men benighted
  The lamp of light deny?
Salvation! O salvation!
  The joyful sound proclaim,
Till each remotest nation
  Has learn'd Messiah's name.

Waft, waft, ye winds, his story
  And you, ye waters, roll,
Till, like a sea of glory,
  It spreads from pole to pole;
Till o'er our ransom'd nature
  The Lamb for sinners slain,
Redeemer, King, Creator,
  In bliss returns to reign.

HEBER.

CIRCULATION OF THE BLOOD.

THE manner in which the blood-vessels are disposed in the human body bears some resemblance to the arrangement of the pipes by which a great city is supplied with water. London is supplied by means of an engine contrived for the purpose of distributing the water of the New River through the city. Large trunks are carried from this machine in different directions; smaller pipes branch out from these trunks into streets, lanes, and alleys; still smaller ones issue from them, and convey the water into private houses. So far the resemblance is complete. These water-pipes represent the *arteries* which carry the blood from the heart to the extremities of the body; but in the human body another contrivance was necessary. The citizens of London may use the water or waste it as they please; but the precious fluid conveyed by the arteries to the ends of the fingers must

be returned to the heart; for on its unceasing circulation our health depends.

In order to effect this purpose, another set of pipes is prepared, called *veins*, which, joining the extremities of the arteries, receive the blood from them, and carry it back again to the heart. The veins present the same general appearance as the arteries; but as it is the office of the arteries to distribute the blood, so it is that of the veins to collect it. Through them it flows back to the heart in a manner just the reverse of that in which it sets out; the minute veins unite in larger branches, the larger branches unite in still larger trunks, till the collected blood is at length poured into the heart through one opening.

The engine that works this curious machinery is the *heart*. The heart is composed of four cavities. Like other muscles, it has the power of contracting; and when it contracts, the sides of its cavities are squeezed together, so as to force out any fluid the heart may at that moment contain. This purpose being effected, the fibres relax, the heart once more becomes hollow, and as it dilates, the blood pours into the cavities from the large vein which brings it back to the heart. The next contraction forces the blood into the arteries, the quantity thus impelled being always equal to that which has just been received; and thus this wonderful organ goes on, alternately contracting and dilating itself, *four thousand* times in an hour. Month after month, year after year, it goes on without weariness or interruption, conveying renewed strength to every part of the body. The two largest cavities of the heart, which send out the blood to the arteries, are called *ventricles;* the two smallest, which receive it from the veins, *auricles.* All the arteries are furnished with valves that play easily forward, but admit not the blood to return to the heart.—(*See Illustrations*, *Fig.* 19.)

In all this there is abundant evidence of wise contrivance. The blood, in going out from the heart. is continually passing from wide tubes into those which are narrower; in coming back. it passes from narrow vessels

into wider; consequently the blood presses the sides of the arteries with greater force than it acts against the coats of the veins. To prevent any danger from this difference of pressure, the arteries are formed of much tougher and stronger materials than the veins. This is one difference between the two; there is another still more strikingly illustrative of the care of the Great Artificer. As a wound in the arteries, through which the blood passes with such force from the heart, would be more dangerous than a wound in the veins, the arteries are defended, not only by their stronger texture, but by their more sheltered situation. They are deeply buried among the muscles, or they creep along grooves made for them in the bones. The under side of the ribs is sloped and furrowed, to allow these important tubes to pass along in safety; and in the fingers, which are liable to so many casualties, the bones are hollowed out in the inside like a scoop. Along this channel the artery runs in such security, that you might cut your finger across to the bone without doing it any injury. Mrs Hack.

A MOONLIGHT NIGHT AT VENICE.

'Tis
A goodly night; the cloudy wind which blew
From the Levant hath crept into its cave,
And the broad moon has brighten'd. What a stillness!
And what a contrast with the scene I left,
Where the tall torches and the silver lamps
Spread over the reluctant gloom, which haunts
Those vast and dimly-latticed galleries,
A dazzling mass of artificial light,
Which show'd all things, but nothing as they were.
There Age essaying to recall the past,
After long striving for the hues of youth
At the sad labour of the toilet, and
Full many a glance at the too faithful mirror,
Forgot itself, and trusting to the falsehood
Of the indulgent beams, which show, yet hide,
Believed itself forgotten, and was fool'd.

There youth, which needed not, nor thought of such
Vain adjuncts, lavish'd its true bloom, and health,
And bridal beauty, in the unwholesome press
Of flush'd and crowded wassailers, and wasted
Its hours of rest in dreaming this was pleasure,
And so shall waste them till the sunrise streams
On sallow cheeks and sunken eyes, which should not
Have worn this aspect yet for many a year.
The music, and the banquet, and the wine—
The garlands, the rose-odours, and the flowers—
The sparkling eyes, and flashing ornaments—
All the delusion of the dizzy scene,
Its false and true enchantments,—art and nature,
Which swam before my giddy eyes, that drank
The sight of beauty as the parch'd pilgrim's
On Arab's sands the false mirage, which offers
A lucid lake to his eluded thirst—
Are gone. Around me are the stars and waters—
Worlds mirror'd in the ocean, goodlier sight
Than torches glared back by a gaudy glass;
And the great element, which is to space
What ocean is to earth, spreads its blue depths,
Soften'd with the first breathings of the spring;
The high moon sails upon her beauteous way,
Serenely smoothing o'er the lofty walls
Of those tall piles and sea-girt palaces,
Whose porphyry pillars, and whose costly fronts,
Seem each a trophy of some mighty deed
Rear'd up from out the waters, scarce less strangely
Than those more massy and mysterious giants
Of architecture, those Titanian fabrics,
Which point in Egypt's plains to times that have
No other record. All is gentle: nought
Stirs rudely; but, congenial with the night,
Whatever walks is gliding like a spirit.
The tinklings of some soft guitars;—the dash
Phosphoric of the oar, or rapid twinkle
Of the far lights of skimming gondolas,
And the responsive voices of the choir
Of boatmen answering back with verse for verse;
Some dusky shadow chequering the Rialto;
Some glimmering palace-roof or tapering spire,

Are all the sights and sounds which here pervade
The ocean-born and earth-commanding city.—
How sweet and soothing is this hour of calm! BYRON.

RHETORICAL EXTRACTS.

1. AMIDST this company stood Mr Watt of Birmingham, the man whose genius discovered the means of multiplying our national resources to a degree perhaps even beyond his own stupendous powers of calculation; bringing the treasures of the abyss to the summit of the earth; giving the feeble arm of man the momentum of an Afrit; commanding manufactures to arise, as the rod of the prophet produced water in the desert; affording the means of dispensing with that "time and tide which wait for no man;" and of sailing without that wind which defied the commands and threats of Xerxes himself. This potent commander of the elements—this abridger of time and space—was not only the most profound man of science, the most successful combiner of powers and calculator of numbers as adapted to practical purposes—was not only one of the most generally well-informed, but one of the best and kindest of human beings. Methinks I yet see and hear what I shall never see or hear again. In his 85th year, the alert, kind, benevolent old man had his attention at every one's question, his information at every one's command. His talents and fancy ever flowed on every subject. One gentleman was a deep philologist—he talked with him on the origin of the alphabet as if he had been coeval with Cadmus; another, a celebrated critic—you would have said the old man had studied political economy and belles lettres all his life; —of science it is unnecessary to speak—it was his own distinguished walk. Sir WALTER SCOTT.

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2. IF nature has denied to Britain the fruitful vine, the fragrant myrtle, the spontaneous soil, and the beautiful climate, she has also exempted her from the parching drought, the deadly siroc, and the frightful tornado. If

our soil is poor and churlish, and our skies cold and frowning, the serpent never lurks within the one, nor the plague within the other. If our mountains are bleak and barren, they have at least nursed within their bosoms a race of men whose industry and intelligence have performed greater wonders, and supply a more inexhaustible fund of wealth, than all the mines of Mexico and Hindostan. If other nations furnish us with the materials of our manufactures, ours are the skill and industry that have enhanced their value a thousandfold; ours are the capital and enterprise that have applied the great inventions of Watt and Arkwright, and made the ascendency of this little island be felt in the remotest corners of the world; ours, in a word, are those institutions, civil, political, and religious, that have made us the envy of surrounding nations, and raised us to a pinnacle of greatness from which nothing but intestine foes can ever thrust us down. M'DIARMID.

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3. LIBERTY is commensurate with and inseparable from British soil; British law proclaims even to the stranger and the sojourner, the moment he sets his foot upon British earth, that the ground on which he treads is holy, and consecrated by the genius of Universal Emancipation! No matter in what language his doom may have been pronounced;—no matter what complexion incompatible with freedom an Indian or an African sun may have burnt upon him;—no matter in what disastrous battle his liberty may have been cloven down;—no matter with what solemnities he may have been devoted upon the altar of slavery; the first moment he touches the sacred soil of Britain, the altar and the god sink together in the dust; his soul walks abroad in her own majesty; his body swells beyond the measure of his chains, that burst from around him; and he stands redeemed, regenerated, and disenthralled, by the irresistible genius of Universal Emancipation! CURRAN.

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4. THE first great obstacle to the extinction of war is

the way in which the heart of man is carried off from its horrors by the splendour of its accompaniments. There is a feeling of the sublime in contemplating the shock of armies, just as there is in contemplating the devouring energy of a tempest; and this so engrosses the whole man, that his eye is blind to the tears of bereaved parents, and his ear is deaf to the piteous moan of the dying, and the shriek of their desolated families.—There is a gracefulness in the picture of a youthful warrior burning for distinction in the field:—and this side of the picture is so much the exclusive object of our regard as to disguise from our view the mangled carcasses of the fallen, and the writhing agonies of the hundreds and the hundreds more who have been laid on the cold ground, where they are left to languish and to die. There no eye pities them. No sister is there to weep over them. There no gentle hand is present to ease the dying posture, or to bind up the wounds, which, in the maddening fury of the combat, have been given and received by the children of one common Father. CHALMERS.

5.—*Titus.* It must be—
And yet it moves me, Romans! it confounds
The counsel of my firm philosophy,
That Ruin's merciless ploughshare must pass o'er,
And barren salt be sown on yon proud city.
As on our olive-crowned hill we stand,
Where Kedron at our feet its scanty waters
Distils from stone to stone with gentle motion,
As through a valley sacred to sweet peace,
How boldly doth it front us! how majestically!
Like a luxurious vineyard, the hill-side
Is hung with marble fabrics, line o'er line,
Terrace o'er terrace, nearer still, and nearer
To the blue heavens. There bright and sumptuous palaces,
With cool and verdant gardens interspersed;
There towers of war that frown in massy strength;
While over all hangs the rich purple eve,
As conscious of its being her last farewell
Of light and glory to that fated city.
And, as our clouds of battle, dust, and smoke,

Are melted into air, behold the Temple
In undisturb'd and lone serenity,
Finding itself a solemn sanctuary
In the profound of heaven! It stands before us
A mount of snow, fretted with golden pinnacles!
The very sun, as though he worshipp'd there,
Lingers upon the gilded cedar roofs,
And down the long and branching porticos,
On every flowery-sculptured capital,
Glitters the homage of his parting beams.
By Hercules! the sight might almost win
The offended majesty of Rome to mercy. MILMAN.

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6. PERHAPS you say that your neglect of religion is only *deferring* it; that you are sensible it is a concern which you must attend to some time; and that you are fully resolved to do so in maturer life. And are you saying this with the images before your mind of one, and another, and still another, within the circle of your knowledge whom you have seen cut off in youth? Go, stand by their graves and repeat it there; for there is folly in it, if you could not on those spots repeat it with undisturbed assurance: say, over those dead forms, now out of sight, but which you can so well in memory recall, such as you saw them, alert and blooming: say there deliberately, that you know not why you should not be quite at your ease in delaying to some future time your application to religion. It is possible that some of them, in approaching the last hour, expressed to you an earnest admonition on this subject, conjuring you, in the name of a friend dying in youth, to beware of the guilt and hazard of delay. If so, go to the grave of that one especially, and there pronounce, that an impertinence was uttered at a season when every sentence ought to be the voice of wisdom. Say, "I am wiser in this carelessness of my spirit than thou wast in the very solemnity of death."—Why should you shrink at the idea of doing this? and if you dare not do it, what verdict are you admitting, by implication, as the just one to be pronounced on your conduct? FOSTER.

7. This writer shows mercy neither to the living nor to the dead, provided only they have the original sin of being Scotch. The very martyrs, to whom we owe much of that freedom in which we now rejoice as a cherished birthright, whose memories are dear to every man who is capable of appreciating high principle, patient endurance, unconquerable faith, and by whose humble graves the soil of our country is consecrated and hallowed,—these very martyrs he has tried to rob of their peculiar honours, and to lower in the estimation of the people for whose liberties they fought and died. He might have spared us this outrage at least on our feelings. Even if he had been at once a native and a resident of England, it was in miserable taste to leave his subject for the purpose of heaping insult on ancestors whom we venerate. But it is intolerable that this should be done by one who has voluntarily migrated into our land, has sworn allegiance to that polity for which our martyrs struggled, and is eating, at this very moment, the pleasant fruits of that plant of renown which they rooted with their hand and watered with their blood. He represents them as men mistaken in the work that God required of them; and as falling like Homer's heroes rather than Christ's confessors, prophesying retribution, and denouncing judgment, against their oppressors! O, it is easy for those whom their forefathers have left nothing to fear, and nothing to suffer from the oppressor's arm,—for whom the battle has been won, and the yoke broken, and the blessing secured,—and to whom has descended the privilege of living secure and dying in peace;—it is easy for such to talk of the failings and aberrations that occasionally mingled with the virtuous achievements by which this great deliverance was wrought out, and to illustrate them with a careless mixture of Christian and classical allusion; but it is base—base beyond endurance—thus to requite the doings and the sufferings of those ancient worthies, who, at the expense of their lives, asserted for their posterity that precious freedom, without which all other possessions are poor and unsatisfying! Andrew Thomson.

8. Breathes there the man, with soul so dead,
Who never to himself hath said,
"This is my own, my native land!"
Whose heart hath ne'er within him burn'd,
As home his footsteps he hath turn'd,
From wandering on a foreign strand!
If such there breathe, go, mark him well;
For him no minstrel-raptures swell:
High though his titles, proud his name,
Boundless his wealth as wish can claim;
Despite those titles, power, and pelf,
The wretch, concentred all in self,
Living, shall forfeit fair renown,
And, doubly dying, shall go down
To the vile dust, from whence he sprung,
Unwept, unhonour'd, and unsung.

O Caledonia! stern and wild,
Meet nurse for a poetic child!
Land of brown heath and shaggy wood,
Land of the mountain and the flood,
Land of my sires! what mortal hand
Can e'er untie the filial band,
That knits me to thy rugged strand!

Sir Walter Scott.

SECTION VI.

MIRACLES.

Father. Henry. Eliza.

H. You did not, father, in our last conversation, inform us what part of Christianity was to be the subject this evening.

F. I purposely omitted it, Henry, that I might ask you a question. Supposing that certain persons were to come, say from Russia, to the court of England, and de-

clare that they were the bearers of important communications from the emperor, do you think the British ministers would receive them without farther inquiry?

H. No; I think the king's ministers would ask what proofs they could give that they were sent by him.

F. Were the messengers to say, "Here are several letters and papers that were dictated by the emperor, and written by his secretaries, and here is the imperial seal affixed to every one of them;" what do you think, Eliza, his majesty's ministers would reply to them?

E. I think, if they knew the imperial seal, they would believe that the bearers were ambassadors from his imperial majesty.

F. You are right; and they would forthwith treat with them upon the business on account of which they had come to the court of England.

H. But what has all this, father, to do with Christianity?

F. The Scriptures, Henry, contain a message from God. The prophets and apostles were like secretaries to communicate the Divine will to men; and God did not send them to make known his will, and leave them merely to assert that they were sent by him. The "great salvation, at the first begun to be spoken by the Lord, was confirmed by them that heard him, God also bearing them witness both with *signs* and *wonders*, and with *divers miracles* and *gifts* of the Holy Ghost."

H. Now I understand the reason of your question. Do not you mean to say, that the miracles which God enabled his servants to perform formed the Divine *seal* to their mission?—But though I understand how the emperor's seal would prove those who showed it to be his accredited ambassadors, I do not exactly perceive how a miracle proves the authority of the Almighty.

F. That is because you have not a precise notion of what it is that constitutes a miracle.

H. The wonderful things which our Saviour did were miracles, were they not?

F. They were; but an event is not necessarily miraculous because it appears wonderful. A miracle is a sen-

sible suspension of the laws of nature; and, as none but the Author of Nature can alter or control the laws which he has imposed, a miracle necessarily implies Divine interference, and may therefore be regarded as the seal of the Almighty.

H. But how can we know when a law of nature is suspended?

F. Only by being well acquainted with what is the ordinary course of nature. If we are ignorant of this, we cannot determine whether any particular event is or is not miraculous. It was because the Americans were ignorant of the laws of the heavenly bodies, that they considered the knowledge of Columbus supernatural when he predicted an eclipse of the moon; and in similar cases ignorant men will always err; but, fortunately for our belief in the Scripture-miracles, they were all suspensions of laws with which all human beings are familiar. No man can have a moment's doubt whether such achievements as raising the dead, walking on the sea, healing the sick by a word, &c. be suspensions of the course of nature.

E. But could prophets and apostles not have communicated the messages of God without working miracles?

F. They certainly could; but would men have believed them unless they could prove that God had sent them? Men might have said, "What signs do you show, that we may see and believe?" When God delivered to Moses the message he was to repeat to the Israelites and to Pharoah, Moses said, "Behold they will not believe me, for they will say, The Lord hath not appeared unto thee." The force of this excuse was immediately admitted, and Moses was directed, as a proof of his commission, to exhibit miraculous signs. Our Saviour, in like manner, rested his pretensions exclusively on his miracles: "If I do not the works of my Father, believe me not."

E. In reading the history of the Israelites, I have often been surprised at their regardlessness of the works of Christ.

F. Their conduct shows the infidel state of the human heart. Christ's bitterest enemies confessed that he

did many miracles, but they wickedly ascribed them to the power of Satan, though the very nature of his miracles showed the absurdity of such a base insinuation. There were some indeed that said with Nicodemus, "We know that thou art a teacher come from God, for no man can do these miracles which thou dost, except God be with him." But as a nation they would not receive him.

H. Oh! I think if I had seen Jesus Christ, and the miracles which he did, I would have loved him as my Saviour.

F. Ah! Henry, if you do not love him, and trust in him as he is described in his word, there is reason to fear, that though you had seen him, and beheld all the mighty works which he did, you would not have loved him. We read of some who never saw him, and yet esteemed him precious. We have the same advantages which they had, and if we believe not in him as he is revealed in the gospel of his grace, we would not be persuaded though we had been among the number of his hearers, or the subjects of his healing power.

EFFECTS OF CALORIC.

The principal phenomena which accompany the passage of caloric into substances, are expansion, liquefaction, and vaporization. The phenomena that attend its escape from them, viz. contraction, solidification of fluids, and condensation of vapour, are merely the converse of these.

1. *Expansion.*—The effect of caloric is directly contrary to that of the attraction of cohesion, the one drawing the particles together, the other driving them asunder; and from the continual struggle between these two forces result all the various degrees of consistence which bodies assume. Solids vary in density from that of gold to that of a thin jelly; liquids, from the consistence of melted glass, or melted metals, to that of ether, which is the lightest of all liquids; and the different aeriform fluids are susceptible of no less variety in their degrees of density. Nay more, every individual body admits of

different degrees of consistence. If a piece of iron, which, in its ordinary state, exactly fits a ring, be heated redhot, its dimensions will be so much increased by the caloric that has penetrated into it, that it will be much too large for the ring. Different bodies dilate too in very different proportions. This is the case with metals, and other kinds of solid bodies, and still more so with liquids.

It is in consequence of the great susceptibility of dilatation in liquids, that they are used for filling thermometrical tubes. A thermometer consists of a tube, with a bulb containing a fluid, whose degrees of dilatation are indicated by a scale to which the tube is fixed. The fluid generally used for this purpose is mercury, because its dilatations and contractions are found to correspond more exactly to the additions and subtractions of caloric than those of any other fluid. The degree on the scale that indicates the boiling point simply means, that when the mercury is sufficiently dilated to rise to this point, the heat is such, that water exposed to the same temperature will boil; and when the fluid is so much condensed as to sink to the freezing-point, we are to understand that water will freeze at that temperature. The extreme points of the scale are not the same in all thermometers, nor are the degrees always divided in the same manner. Fahrenheit's scale, which is preferred by the English, is divided into 212 degrees, in which 32° corresponds with the freezing-point, and 212° with the point of boiling water. Reaumur's, which is preferred by the French, is divided only into 80 degrees, in which 0° denotes the freezing-point, and 80° that of boiling water.—(*See Illustrations*, *Fig.* 20.)

As liquids expand more readily than solids, so aeriform fluids are more expansible than liquids; and one circumstance respecting their dilatation deserves to be particularly noticed—they all undergo the same degree of expansion from equal augmentations of temperature, though they vary in density more than either liquids or solids. This uniformity of expansibility, extraordinary as it may appear, is readily accounted for; for if bodies owe their different susceptibilities of expansion to their various degrees of attraction of cohesion, no such difference can be

expected in permanently elastic fluids, since in these the attraction of cohesion does not exist, their particles being, on the contrary, possessed of an elastic or repulsive power; they will therefore all be equally expanded by equal degrees of caloric.

2. *Liquefaction.*—All bodies are either solid, liquid, or gaseous; and the form they assume depends upon the relative force of cohesion and caloric. As it is easy to increase or diminish the quantity of caloric in any substance, it follows that the form of bodies may be made to vary at pleasure; that is, by a sufficiently intense heat every solid may be converted into a fluid, and every fluid into the aeriform state. This inference is justified by experience so far that it may safely be considered a general law. The converse ought also to be true; and, accordingly, various gases have been condensed, by cold and pressure, into liquids, and all liquids, except alcohol, have been solidified.

The most important circumstance relative to liquefaction is the discovery of Dr Black, that a large quantity of caloric disappears, or becomes insensible to the thermometer, during the process. If ice or snow of a temperature below the freezing-point be placed above a lamp, it will indicate a gradual rise of temperature till it arrive at 32° and begin to melt (this may be ascertained by placing a thermometer in it), but no farther rise will take place during the process of liquefaction. It will remain stationary at 32°, notwithstanding that it is all along receiving accessions of heat from the lamp, till the process is completed; and all the caloric which is added will become insensible. The explanation which Dr Black gave of these phenomena constitutes what is called his doctrine of *latent heat.* He considered that caloric loses its property of acting on the thermometer, in consequence of combining chemically with the solid substance, and that the liquefaction is the result of this combination.*

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* As so much heat disappears during liquefaction, it follows that caloric must be evolved when a liquid passes into a solid. This

3. *Vaporization.*—Caloric appears to be the cause of vaporization as well as of liquefaction, and it is a general opinion that a sufficiently intense heat would convert every liquid and solid into vapour, though a considerable number of bodies resist the strongest heat of our furnaces without vaporizing. Some solids, as arsenic and sal-ammoniac, pass at once into vapour without being liquefied; but most of them become liquid before assuming the elastic condition. Vaporization is conveniently studied under two heads, Ebullition or Boiling, and Evaporation. In the first, the production of vapour is so rapid that its escape gives rise to a visible commotion in the liquid; in the second it passes off quietly and insensibly.

1. The temperature at which vapour rises with sufficient freedom for causing the phenomena of ebullition is called the boiling-point. The heat requisite for this effect varies with the nature of the fluid. Thus, sulphuric ether boils at 96° F., alcohol at 173°, and pure water at 212°; while oil of turpentine must be raised to 316°, and mercury to 660°, before either exhibits marks of ebullition. Even the boiling-point of the same liquid is liable to be affected by several circumstances. The nature of the vessel has some influence upon it. Thus, pure water boils precisely at 212° in a metallic vessel, and at 214° in one of glass. It is likewise affected by the presence of foreign particles. But the circumstance which has the greatest influence is variation of pressure. All bodies upon the earth are constantly exposed to considerable pressure; for the atmosphere itself presses with a force equivalent to a weight of 15 pounds on every square inch of surface. Liquids are exposed to this pressure as well as solids, and their tendency to take the form

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may easily be proved. The temperature of water in the act of freezing never falls below 32° F., though it be exposed to an atmosphere in which the thermometer is at zero. It is obvious that the water can preserve its temperature in a medium so much colder than itself, only by the caloric which it loses being instantly supplied; and it is no less clear that the only source of supply is the caloric that was insensible in the fluid.

of vapour is very much counteracted by it. In fact, they cannot enter into ebullition at all till their particles have acquired such an elastic force as enables them to overcome the pressure upon their surfaces; that is, till they press against the atmosphere with the same force as the atmosphere against them. The only time at which the pressure of the atmosphere is equal to a weight of 15 pounds on every square inch of surface, is when the barometer stands at 30 inches, and then only does water boil at 212° F. If the pressure be less, that is, if the barometer fall below 30 inches, then the boiling-point of water, and every other liquid, will be lower than usual; or, if the barometer rise above 30 inches, the temperature of ebullition will be proportionally increased. This is the reason why water boils at a lower temperature on the top of a hill than in the valley beneath it; for as the column of air diminishes in length as we ascend, its pressure must likewise suffer a proportional diminution. The ratio between the depression of the boiling-point and the diminution of the atmospherical pressure is so exact, that it has been proposed as a method for determining the heights of mountains. An elevation of 530 feet makes a diminution of one degree of Fahrenheit. The influence of the atmosphere over the point of ebullition is best shown by removing its pressure altogether. Fluids boil in vacuo at a temperature 140 degrees lower than in the open air. Thus water boils at 72° F., alcohol at 33°, and ether at —44°. This proves that a liquid is not necessarily hot because it boils.*

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* Water cannot be heated under common circumstances beyond 212° F., because it then acquires such an expansive force as enables it to overcome the atmospheric pressure, and to fly off in the form of vapour. But if subjected to sufficient pressure, it may be heated to any extent without boiling. This is done by heating water while confined in a strong copper vessel, called Papin's Digester. A large quantity of vapour collects above the water, which checks the ebullition by the pressure it exerts upon the surface of the liquid. There is no limit to which water may not be heated in this way, provided the vessel is strong enough to confine the vapour; but the expansive force of steam under these circumstances is so enormous as to over-

The formation of vapour is attended, like liquefaction, with a loss of sensible caloric. This is proved by the well-known fact, that the temperature of steam is precisely the same as that of the boiling water from which it rises; so that all the caloric which enters into the liquid is solely employed in converting a portion of it into vapour, without affecting the temperature of either in the slightest degree, provided the latter is permitted to escape with freedom. The caloric which then becomes latent is again set free when the vapour is condensed into water.

2. *Evaporation* takes place at common temperatures,

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come the greatest resistance. In estimating the power of steam, it should be remembered that vapour, if separated from the liquid which produced it, does not possess a greater elasticity than an equal quantity of air. If, for example, the digester was full of steam at 212°, no water in the liquid state being present, it may be heated to any degree, even to redness, without danger of bursting. But if water be present, then each addition of caloric causes a fresh portion of steam to rise, which adds its own elastic force to that of the vapour previously existing; and in consequence an excessive pressure is soon exerted against the inside of the vessel. The elasticity of steam is employed as a moving power in the steam-engine, the construction of which depends on two properties of steam, namely, the expansive force communicated to it by caloric, and its ready conversion into water by cold. The effect of both these properties is well shown by a little instrument devised by Dr Wollaston. It consists of a cylindrical glass tube, six inches long, nearly an inch wide, and blown out into a little ball at one end. A piston is accurately fitted to the cylinder, so as to move up and down the tube with freedom. When the piston is at the bottom of the tube, it is forced up by causing a portion of water, previously placed in the ball, to boil, by means of a spirit-lamp. On dipping the ball into cold water, the steam which occupies the cylinder is suddenly condensed, and the piston is forced down by the pressure of the air above it. By the alternate application of heat and cold, the same movements are reproduced, and may be repeated for any length of time. The moving power of the steam engine is the same as in this apparatus. The only essential difference between them is in the mode of condensing the steam. In the steam-engine, the steam is condensed in a separate vessel, where there is a regular supply of cold water for the purpose. By this contrivance, which constitutes the great improvement of Watt, the temperature of the cylinder never falls below 212°.

as may be proved by exposing water in a shallow vessel to the air for a few days, when it will gradually diminish, and at last disappear entirely. Most fluids, if not all of them, are susceptible of this gradual dissipation; and it may also be observed in some solids, as, for example, in camphor. Evaporation is much more rapid in some fluids than in others, and it is always found that those liquids whose boiling-point is lowest, evaporate with the greatest rapidity.

The chief circumstances that influence this process are extent of surface, and the state of the air as to temperature, dryness, stillness, and density. The effect of heat in promoting it may easily be shown by putting an equal quantity of water into two saucers, one of which is placed in a warm the other in a cold situation. The former will be quite dry before the latter has suffered an appreciable diminution. When water is covered by a stratum of dry air, the evaporation is rapid even when its temperature is low; whereas it goes on very tardily if the atmosphere contains much vapour, even though the air be very warm. It is far slower in still air than in a current, because the air immediately in contact with the water soon becomes moist, and thus puts a check to it. Pressure too has a remarkable influence over it. This is easily proved by placing ether in the vacuum of an air-pump, when vapour rises so abundantly as to produce ebullition.*

The presence of watery vapour in the atmosphere is

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* As a large quantity of caloric passes from a sensible to an insensible state during the formation of vapour, it follows that cold should be generated by evaporation. Water placed under the exhausted receiver of an air-pump evaporates with great rapidity, and so much cold is generated as would freeze the water, did the vapour continue to rise for some time with the same velocity. But the vapour itself soon fills the vacuum, and retards the evaporation by pressing upon the surface of the water. This difficulty may be avoided by putting under the receiver a substance, such as sulphuric acid, which has the property of absorbing watery vapour, and consequently of removing it as quickly as it forms. Such is the principle of Sir John Leslie's method for freezing water by its own evaporation.

owing to evaporation. All the accumulations of water upon the surface of the earth are subjected by its means to a natural distillation; the impurities with which they are impregnated remain behind, while the pure vapour ascends into the air, gives rise to a multitude of meteorological phenomena, and after a time descends again upon the earth as rain. And as evaporation goes on to a certain extent, even at low temperatures, it is probable that the atmosphere is never absolutely free of vapour.

Abridged from TURNER'S *Elements of Chemistry.*

THE SAXON AND THE GAEL.—*The Interview.*

So toilsome was the road to trace,
The guide, abating of his pace,
Led slowly through the pass's jaws,
And ask'd Fitz-James, by what strange cause
He sought these wilds, traversed by few,
Without a pass from Roderick Dhu?

"Brave Gael, my pass, in danger tried,
Hangs in my belt, and by my side:
Yet, sooth to tell," the Saxon said,
"I dreamt not now to claim its aid.
When here, but three days since, I came,
Bewilder'd in pursuit of game,
All seem'd as peaceful and as still
As the mist slumbering on yon hill;
Thy dangerous Chief was then afar,
Nor soon expected back from war."—
"But, stranger, peaceful since you came,
Bewilder'd in the mountain game,
Whence the bold boast by which you show
Vich-Alpine's vow'd and mortal foe?"—
"Warrior, but yestermorn, I knew
Nought of thy chieftain, Roderick Dhu,
Save as an outlaw'd desperate man,
The chief of a rebellious clan,
Who, in the Regent's court and sight,
With ruffian dagger stabb'd a knight;
Yet this alone might from his part
Sever each true and loyal heart."

Wrothful at such arraignment foul,
Dark lower'd the clansman's sable scowl:
A space he paused, then sternly said,
"And heardst thou why he drew his blade?
Heardst thou that shameful word and blow
Brought Roderick's vengeance on his foe?
What reck'd the chieftain if he stood
On Highland heath, or Holy-Rood?
He rights such wrong where it is given,
If it were in the court of Heaven."—
"But then, thy chieftain's robber life!—
Winning mean prey by causeless strife:
Wrenching from ruin'd Lowland swain
His herds and harvests rear'd in vain.—
Methinks a soul like thine should scorn
The spoils from such foul foray borne."

"Saxon, from yonder mountain high,
I mark'd thee send delighted eye,
Far to the south and east, where lay,
Extended in succession gay,
Deep waving fields and pastures green,
With gentle slopes and groves between:—
These fertile plains, that soften'd vale,
Were once the birthright of the Gael;
The stranger came with iron hand,
And from our fathers reft the land.
Where dwell we now! See, rudely swell
Crag over crag, and fell o'er fell.
Ask we this savage hill we tread
For fatten'd steer or household bread;
Ask we for flocks these shingles dry,
And well the mountain might reply,—
'To you, as to your sires of yore,
Belong the target and claymore;
I give you shelter in my breast,
Your own good blades must win the rest!
Pent in this fortress of the North,
Thinkst thou we will not sally forth
To spoil the spoiler as we may,
And from the robber rend the prey?
Ay,—while upon yon fertile plain
The Saxon rears one shock of grain;

While, of ten thousand flocks, their strays
But one along yon river's maze,—
The Gael, of plain and river heir,
Shall, with strong hand, redeem his share."

"Well, let it pass; nor will I now
Fresh cause of enmity avow,
To chafe thy mood and cloud thy brow.
Enough, I am by promise tied
To match me with this man of pride:
Twice have I sought Clan-Alpine's glen
In peace; but when I come agen,
I come with banner, brand, and bow,
As leader seeks his mortal foe;
For love-lorn swain, in lady's bower,
Ne'er panted for the appointed hour,
As I, until before me stand
This rebel Chieftain and his band!"

"Have, then, thy wish!"—He whistled shrill,
And he was answer'd from the hill;
Wild as the scream of the curlew,
From crag to crag the signal flew.
Instant, through copse and heath, arose
Bonnets, and spears, and bended bows;
On right, on left, above, below,
Sprung up at once the lurking foe;
From shingles gray their lances start,
The bracken-bush sends forth the dart,
The rushes and the willow-wand
Are bristling into axe and brand,
And every tuft of broom gives life
To plaided warrior arm'd for strife.
That whistle garrison'd the glen
At once with full five hundred men,
As if the yawning hill to heaven
A subterranean host had given.
Watching their leader's beck and will,
All silent there they stood and still,
Like the loose crags, whose threatening mass
Lay tottering o'er the hollow pass,
As if an infant's touch could urge
Their headlong passage down the verge.

The Mountaineer cast glance of pride
Along Benledi's living side,
Then fix'd his eye and sable brow
Full on Fitz-James—"How sayst thou now?
These are Clan-Alpine's warriors true;
And, Saxon,—I am Roderick Dhu!"

Fitz-James was brave:—though to his heart
The life-blood thrill'd with sudden start,
He mann'd himself with dauntless air,
Return'd the Chief his haughty stare.
His back against a rock he bore,
And firmly placed his foot before:—
"Come one, come all! this rock shall fly
From its firm base as soon as I."
Sir Roderick mark'd—and in his eyes
Respect was mingled with surprise,
And the stern joy which warriors feel
In foemen worthy of their steel.
Short space he stood—then waved his hand:
Down sunk the disappearing band:
Each warrior vanish'd where he stood,
In broom or bracken, heath or wood;
It seem'd as if their mother Earth
Had swallow'd up her warlike birth.
The wind's last breath had toss'd in air
Pennon, and plaid, and plumage fair,—
The next but swept a lone hill-side,
Where heath and fern were waving wide.

Fitz-James look'd round—yet scarce believed
The witness that his sight received;
Sir Roderick in suspense he eyed,
And to his look the Chief replied,—
"Fear nought—nay, that I need not say—
But—doubt not aught from mine array.
Thou art my guest:—I pledged my word
As far as Coilantogle ford:
Nor would I call a clansman's brand
For aid against one valiant hand,
Though on our strife lay every vale
Rent by the Saxon from the Gael.
So move we on: I only meant
To show the reed on which you leant,

Deeming this path you might pursue
Without a pass from Roderick Dhu."
Sir WALTER SCOTT—*Lady of the Lake.*

THE SAXON AND THE GAEL CONTINUED.

The Combat.

THE Chief in silence strode before,
And reach'd that torrent's sounding shore,
Which, daughter of three mighty lakes,
From Vennacher in silver breaks,
Sweeps through the plain, and ceaseless mines
On Bochastle the mouldering lines,
Where Rome, the Empress of the World,
Of yore her eagle-wings unfurl'd.
And here his course the Chieftain staid,
Threw down his target and his plaid,
And to the Lowland warrior said:—
"Bold Saxon! to his promise just,
Vich-Alpine has discharged his trust,
This murderous chief, this ruthless man,
This head of a rebellious clan,
Hath led thee safe, through watch and ward,
Far past Clan-Alpine's outmost guard.
Now man to man, and steel to steel,
A Chieftain's vengeance thou shalt feel.
See, here, all vantageless I stand,
Arm'd, like thyself, with single brand:
For this is Coilantogle ford,
And thou must keep thee with thy sword."—

The Saxon paused:—"I ne'er delay'd,
When foeman bade me draw my blade;
Nay more, brave Chief, I vow'd thy death:
Yet sure thy fair and generous faith,
And my deep debt for life preserved,
A better meed have well deserved:
Can nought but blood our feud atone?
Are there no means?"—"No, stranger, none!
And here,—to fire thy flagging zeal,—
The Saxon cause rests on thy steel;

For thus spoke Fate by prophet bred
Between the living and the dead;
'Who spills the foremost foeman's life,
His party conquers in the strife.' "—
"Then, by my word," the Saxon said,
"The riddle is already read.
Seek yonder brake beneath the cliff,—
There lies Red Murdoch, stark and stiff.
Thus Fate has solved her prophecy,
Then yield to Fate, and not to me.
To James, at Stirling, let us go,
When, if thou wilt be still his foe,
Or if the King shall not agree
To grant thee grace and favour free,
I plight mine honour, oath, and word,
That, to thy native strengths restored,
With each advantage shalt thou stand,
That aids thee now to guard thy land."

Dark lightning flash'd from Roderick's eye—
"Soars thy presumption then so high,
Because a wretched kern ye slew,
Homage to name to Roderick Dhu?
He yields not, he, to man nor Fate!
Thou addst but fuel to my hate:—
My clansman's blood demands revenge.
Not yet prepared for fight?—I change
My thought, and hold thy valour light
As that of some vain carpet-knight,
Who ill deserves my courteous care,
And whose best boast is but to wear
A braid of his fair lady's hair."
—"I thank thee, Roderick, for the word!
It nerves my heart, and steels my sword;
For I have sworn this braid to stain
In the best blood that warms thy vein.
Now, truce, farewell! and, ruth, begone!
Yet think not that by thee alone,
Proud Chief! can courtesy be shown;
Though not from copse, or heath, or cairn,
Start at my whistle clansmen stern,
Of this small horn one feeble blast
Would fearful odds against thee cast.

But fear not—doubt not—which thou wilt—
We try this quarrel hilt to hilt."
Then each at once his falchion drew,
Each on the ground his scabbard threw,
Each look'd to sun, and stream, and plain,
As what they ne'er might see again;
Then foot, and point, and eye opposed,
In dubious strife they darkly closed.
Ill fared it then with Roderick Dhu,
That on the field his targe he threw,
Whose brazen studs and tough bull-hide
Had death so often dash'd aside;
For, train'd abroad his arms to wield,
Fitz-James's blade was sword and shield.
He practised every pass and ward,
To thrust, to strike, to feint, to guard;
While less expert, though stronger far,
The Gael maintain'd unequal war.
Three times in closing strife they stood,
And thrice the Saxon blade drank blood;
No stinted draught, no scanty tide,
The gushing flood the tartans dyed.
Fierce Roderick felt the fatal drain,
And shower'd his blows like wintry rain;
And, as firm rock or castle roof,
Against the winter-shower is proof,
The foe, invulnerable still,
Foil'd his wild rage by steady skill;
Till, at advantage ta'en, his brand
Forced Roderick's weapon from his hand,
And, backward borne upon the lea,
Brought the proud Chieftain to his knee.

"Now, yield thee, or"—the Saxon said,
"Thy heart's blood, Chieftain, dyes my blade!"—
"Thy threats, thy mercy, I defy!
Let recreant yield, who fears to die."
—Like adder darting from his coil,
Like wolf that dashes through the toil,
Like mountain-cat who guards her young,
Full at Fitz-James's throat he sprung;
Received, but reck'd not of a wound,
And lock'd his arms his foeman round.—

Now, gallant Saxon, hold thine own!
No maiden's hand is round thee thrown!
That desperate grasp thy frame might feel,
Through bars of brass and triple steel!—
They tug, they strain! down, down they go,
The Gael above, Fitz-James below.
The Chieftain's gripe his throat compress'd;
His knee was planted in his breast;
His clotted locks he backward threw,
Across his brow his hand he drew,
From blood and mist to clear his sight,
Then gleam'd aloft his dagger bright!
—But hate and fury ill supplied
The stream of life's exhausted tide;
And all too late the advantage came,
To turn the odds of deadly game;
For, while the dagger gleam'd on high,
Reel'd soul and sense, reel'd brain and eye.
Down came the blow! but in the heath
The erring blade found bloodless sheath.
The struggling foe may now unclasp
The fainting chief's relaxing grasp;
Unwounded from the dreadful close,
But breathless all, Fitz-James arose. *Id.*

VEGETABLE CLOTHING.—FLAX, HEMP, AND COTTON.

THE *vegetable* matters employed for clothing are chiefly of two kinds; the fibres of plants, and the downy substance in which the seeds are sometimes embedded. The fibrous or stringy texture is very prevalent in vegetables. We see it in the bark and wood of trees, in the stalks of green or herbaceous plants, and in the leaves of all. The longer parallel fibres are held together by shorter cross ones, forming a net-work, cemented by a glutinous matter. The ingenious, though but half-civilized people of Otaheite, have discovered a method of making tolerable cloth of the inner bark of certain trees, by steeping it in water, and then beating it with a wooden mallet. But the more artful way of employing vegetable fibres consists in an entire separation of them from the matter

that held them together, reducing them to clean loose bundles, then twisting them into threads, and lastly interweaving them.

The plants selected in Europe for the purpose of making thread and cloth from their fibres are chiefly flax and hemp. *Flax* (in Latin *linum*, whence the word *linen*) is an annual plant, rising on a single stalk to a moderate height, and crowned with handsome blue flowers, succeeded by globular seed-vessels. It is suffered to grow till the seeds are ripe, and is then plucked up by the hand, laid in little bundles to dry, deprived of its seed-vessels, and then put into pits of water to rot. The purpose of this part of the process is to dissolve a mucilaginous matter, which holds the fibres together; and it is the most disagreeable part of the management of flax, as the smell arising from it while rotting is extremely offensive, and prejudicial to the health. When the flax has lain long enough, it is taken out, washed, dried, then beaten with mallets, combed, and by various other operations so prepared, that the long fibres are got by themselves, clean and loose, in which state they are called *flax;* the shorter and coarser fibres, separated by the comb, are called *tow.* The operation of spinning, which it next undergoes, consists in drawing out, with the fingers, several of the fibres together, and twisting them. The product of spinning is thread, which is more or less fine according to the dexterity of the spinner and the nature of the material. Some thread closer twisted than the rest is kept for needlework, but the greater part is made up in bundles, called linen-yarn, and committed to the weaver.

Weaving may be regarded as a finer kind of matting. To perform it, the threads, which form the length of a piece of cloth, are first disposed in order, and strained by weights to a proper tightness; this is called the *warp.* These threads are divided by an instrument called a reed, into two sets, each composed of every other thread; and while, by the working of a treadle, each set is thrown alternately up and down, the cross-threads, called the *woof* or *weft*, are inserted between them, by means of a little

instrument, sharp at both ends, called a shuttle, which is briskly shot from one of the weaver's hands to the other, placed on the opposite sides of the work, and carries the thread with it. This is the simplest kind of weaving; but numberless are the additional contrivances made for all the curious works wrought in the loom which have been the objects of human ingenuity for many ages.

The linen fabrics are of all degrees of fineness, from coarse sheeting to cambric almost emulating a spider's web. They are brought to that extreme whiteness, which we so much admire, by the process of bleaching. This consists in their exposure to the action of the sun and air, with frequent watering, and often with the help of some acid liquor, which quickens the operation. The value that can be given to a raw material by manufacturing, is in few instances more strikingly exemplified than in the conversion of flax into Brussels lace, some of which sells for several guineas a-yard. Indeed, if you look at a plant of flax growing, and then at the frill of your shirt, you cannot fail to be struck with admiration of human skill and industry.

Hemp is a much taller and stronger plant than flax. It has a square rough stalk, rising to the height of five or six feet, and sending off branches. Its fibrous part consists in the bark surrounding the main stalk. Hemp undergoes the same general preparation as flax before it is consigned to the weaver; but, being of a stronger and coarser texture, it requires more labour to get the fine fibres separate from the rest. Hence it is commonly employed in the more homely manufactures; it is the principal material of sail-cloth, a fabric, the strength of which is required to be proportional to the violence it has to undergo from storms and tempests; and it is equally important to navigation, from its use in making cordage; for which purpose it is taken nearly in a raw state, and twisted into coarse twine, which is afterwards united to make rope.

Whilst the inhabitant of the northern and temperate regions is obliged to exercise much labour and contrivance in procuring his vegetable clothing from the stalks of plants, the native of the fruitful south enjoys the benefit of a material presented in greater abundance, and in a state requiring much less preparation before it is fitted for the manufacturer. This is *cotton*, a white woolly substance contained in the seed-pod of a family of plants, some of which are annual and herbaceous, others perennial and shrubby. The pods, when ripe, open of themselves, and the cotton is plucked out of them by the fingers, with the seeds sticking to it; these are separated by means of mills, which pull out and loosen the down. It is then in a state fit to be sent from the planter to the manufacturer. The farther operations it undergoes are picking, carding, and roving, which last brings off the fibres longitudinally in a continued loose line; these are next twisted and drawn out, so as to make thread or yarn, and the material is then consigned to the weaver. The vast extension of the cotton manufacture in this country has caused these preparatory operations to be performed by a system of complex machinery, the invention of the late Sir Richard Arkwright.

The fabrics made from cotton are probably more various and numerous than from any other material. They comprehend stuffs of all degrees of fineness, from the transparent muslin of a robe, or a turban, to the thick plush and warm bed-quilt. The commerce of Great Britain has, of late years, been peculiarly indebted to the cotton manufacture, which produces clothing for people of all ranks, from Russia to Guinea, and unites elegance with cheapness in an unusual degree. Great quantities of the native fabrics of the east are also imported into Europe. Some of these, from excellence in the material and incomparable manual dexterity and patience in the workmen, though made with very simple machinery, equal in fineness and beauty anything of European manufacture. The natives are said to perform their finest

work in moist cool places under ground, which makes the cotton hold together so as to draw out to the thinnest threads; and the soft and delicate fingers of the Indian women give them the sense of feeling to a degree of nicety much beyond that of Europeans.

It is probable that cotton at present clothes more people in the world than any other substance. Its peculiar advantage, besides cheapness, is the union of warmth with lightness, whence it is fitted for a great variety of climates. To the hot it is better adapted than linen, on account of its absorbing quality, which keeps the skin dry and comfortable. The woolliness of cotton gives a kind of nap to the cloth made of it, which renders it soft to the touch, but apt to attract dust. In the fine muslins this is burned off, by passing them between heated cylinders with such velocity as not to take fire, which, considering the combustibility of cotton, must be a very nice operation. DR AIKIN.

NEGRO SLAVERY.

I WOULD not have a slave to till my ground,
To carry me, to fan me while I sleep,
And tremble when I wake, for all the wealth
That sinews bought and sold have ever earn'd.
No: dear as freedom is, and in my heart's
Just estimation prized above all price,
I had much rather be myself the slave,
And wear the bonds, than fasten them on him.
We have no slaves at home—then why abroad?
And they themselves, once ferried o'er the wave
That parts us, are emancipate and loosed.
Slaves cannot breathe in England; if their lungs
Receive our air, that moment they are free;
They touch our country, and their shackles fall.
That's noble, and bespeaks a nation proud
And jealous of the blessing. Spread it then,
And let it circulate through every vein
Of all your empire; that, where Britain's power
Is felt, mankind may feel her mercy too. COWPER.

'Twas night:—his babes around him lay at rest,
Their mother slumber'd on their father's breast:
A yell of murder rang around their bed;
They woke; their cottage blazed; the victims fled;
Forth sprang the ambush'd ruffians on their prey,
They caught, they bound, they drove them far away:
The white man bought them at the mart of blood;
In pestilential barks they cross'd the flood;
Then were the wretched ones asunder torn,
To distant isles, to separate bondage borne,
Denied, though sought with tears, the sad relief
That misery loves,—the fellowship of grief.
Lives there a savage ruder than the slave?
—Cruel as death, insatiate as the grave,
False as the winds that round his vessel blow,
Remorseless as the gulf that yawns below,
Is he who toils upon the wafting flood,
A Christian broker in the trade of blood;
Boisterous in speech, in action prompt and bold,
He buys, he sells,—he steals, he kills, for gold.
At noon, when sky and ocean, calm and clear,
Bend round his bark, one blue unbroken sphere;
When dancing dolphins sparkle through the brine,
And sunbeam-circles o'er the waters shine;
He sees no beauty in the heaven serene,
No soul-enchanting sweetness in the scene,
But, darkly scowling at the glorious day,
Curses the winds that loiter on their way.
When swoln with hurricanes the billows rise,
To meet the lightning midway from the skies;
When from the unburthen'd hold his shrieking slaves
Are cast at midnight to the hungry waves;
Not for his victims strangled in the deeps,
Not for his crimes the harden'd pirate weeps,
But, grimly smiling, when the storm is o'er,
Counts his sure gains, and hurries back for more.

Montgomery.

What, though thou bask in fortune's smiles,
Proud mistress of a thousand isles,

On the subject sea, like a halcyon's nest,
Yet a cloud is gathering in the west.
A groan comes o'er the western wave;
It is the groan of the tortured slave;
He knows no Heaven, so he prays to thee,
Thou stay of the wretched, thou land of the free!

Yet the groan and the prayer ascend on high,
And they pierce the vaults of the arched sky;
And the ear of Him, who heareth prayer,
Is not shut to the voice of the slave's despair.
His vengeance tarries—His mercy still
Gives thee the choice to turn from ill;
While the plague and the sword impatient wait
For the word of Him—whose will is fate.

That word went forth,—and the blood-bought gold
Fell from the Spaniard's fainting hold;
And the Frenchman sunk to his Haytian grave,
Beneath the shout of the conquering slave.
On them, and for thee, was the judgment sent,
Thou queen of the islands, Repent—Repent—
Be the strength of thine arm extended to save—
Break thou the bonds of the burden'd slave!

And break the heavier bonds of his soul—
Bid the dark clouds of error asunder roll;
And pour upon the benighted eye
The light of the dayspring from on high;
Give, as to thee was freely given,
Thy richest of blessings, the pure word from Heaven;
Tell the slave who shrunk at a master's nod,
"Be the equal of man, and the servant of God."

C. H. T.

THE PROCESS OF NUTRITION.

The mode in which the animal body is nourished is well deserving of your attention. There are two sets of organs devoted to this object, those which perform the functions of circulation and respiration, and those which are concerned in the preparation of the food, and in nu-

trition. The former are situated in a cavity called the chest or thorax; the latter in a cavity beneath, called the cavity of the abdomen. The chest is occupied principally by the heart and the lungs; the abdomen by the stomach, the intestines, the liver, the spleen, and the pancreas or sweetbread. These two cavities or bags are separated by a partition called the diaphragm or midriff, which is partly of a fleshy and partly of a membranous nature, and readily gives way, by its laxity, to the alternate expansion and contraction of the chest in the action of breathing, to which its muscular power eminently contributes.—(*See Illustrations*, *Fig.* 21.)

The first action to which the food is subject is mastication or chewing; and for this purpose, man and most other animals are provided with teeth, which differ in their nature, according to the habits of the animal, and the particular description of food which is intended to nourish it. During the action of chewing, the food is mixed with the *saliva* or *spittle;* it is then carried backwards, and thrown into the *pharynx*, which is a sort of pouch in the back part of the mouth; from which it descends, partly by its own weight and partly by the action of the muscles of the pharynx, into the *œsophagus* or *gullet*, at the extremity of which is the *stomach*, into which the food is deposited.

The *stomach* in man is a membranous bag, not very unlike the shape of the bagpipe, lying across the body, and having two openings; the upper towards the left side, by which it receives food from the gullet, called the cardia, from its supposed sympathy with the heart; and the lower, on the right side, called the pylorus, by which the food passes on to the intestines. Between the coats of the stomach are various small glands, which secrete, and pour into it, a fluid called *gastric* juice, which dissolves the substances taken into the stomach, converts them into a uniform, grayish, pulpy mass, called *chyme*, and thus fits them for becoming nourishment. When the food has undergone, to a sufficient extent, the change which it is meant to suffer in the stomach, an action of the muscu-

lar coats of this organ takes place, by means of which it is passed through the pylorus, or lower orifice, into the intestines. But care is taken that it does not quit the stomach too rapidly for the necessary changes to be effected in it. This is provided for by a sort of contraction at the pylorus, and by the food lying below it, so as to require a considerable exertion of muscular power to carry it up to and then through this opening.

The intestines, which consist of six different parts, bear a considerable resemblance in their structure to the stomach. By means of their muscular coats, the food, after passing through the pylorus, is gradually carried downwards, by a sort of gentle vermicular motion, which is technically called the *peristaltic* motion of the intestines. Next to the stomach, the most important change which the food undergoes is in the first intestine, where the bile, which is a bitter juice secreted from the liver, and the pancreatic juice, which is a fluid resembling saliva, secreted from the pancreas, are added to it; but, over the whole course of the canal, fluids are poured into it, for facilitating its conversion into nourishment. The food is now so altered in its nature as to be capable of affording *chyle*, a fluid which somewhat resembles milk in appearance.—(*See Illustrations*, *Fig.* 22.)

Such is the process of *digestion.* It consists of two operations: one occurring in the stomach, by which the food is converted into chyme; the other in the bowels, by which it is converted into chyle.—The next process is *absorption.* Over the whole interior of the intestines minute vessels, called *lacteals*, open for the purpose of taking up the chyle. They carry it over a considerable space, sometimes uniting as they proceed into large branches, and sometimes dividing into minute ramifications, till they join at last in one large trunk, which is called at its commencement the receptacle of the chyle, and in its continuance the *thoracic duct.* These, together, form a tortuous canal, several inches in length, and about the thickness of a quill. It lies close to the spine, accompanies some of the large blood-vessels, and, ascending to the upper part of the chest delivers its contents

into a large vein near the heart, called the left subclavian; and these contents then form a part of the general mass of the blood.

But the chyle, thus absorbed by the lacteals and the thoracic duct, is not fitted at once to unite with the blood, and thereby to produce that compound fluid which supplies nourishment to the animal body; it must pass through the *lesser* circulation. The *greater* circulation, that is, the mode in which the blood is transmitted from the heart to the different parts of the body by the arteries, and returned by the veins to be again circulated, has already been explained.* But it is to be observed, that there is an intermediate or *lesser* circulation through the lungs. The chyle enters the veins, and the veins convey the blood to the right side of the heart, from whence it is carried through the lungs. It is then brought back to the left side of the heart, and forthwith transmitted by the arteries all over the body, to be brought back by the veins, and to be continually subject to a repetition of the same career. There is thus a sort of double circulation: one side of the heart circulating the blood through the lungs, the other over the body. The necessity for the lesser circulation arises from this, that blood is not fitted for the support of the system when it is first received into the heart with the recent addition of chyle. It is only blood of a florid red or scarlet colour, such as is found in the arteries, that is adapted to the nutritive purposes of the system; but that which is contained in the veins is of a dark or Modena red, and therefore its nature must be ameliorated before it can be of any value. This is effected by spreading it out in the lungs, where it is freely exposed to the action of the atmosphere during the process of respiration, and where it is properly and finally assimilated.—When the venous blood is received into the heart it is of a dark colour; it circulates through the lungs, and it returns florid or proper blood. It is then circulated by the arteries; it furnishes the materials for the growth of parts, and for the

* *Vide* page 195.

formation of the various secretions of the body; and after serving these purposes, it is returned by the veins of an altered colour and character, and unable further to nourish and support. It receives the addition of fresh materials from the food, is then elaborated in the lungs, and again undergoes the same process.

A VOYAGE ROUND THE WORLD.

EMBLEM of Eternity,
Unbeginning, endless Sea!
Let me launch my soul on thee.
  Sail, nor keel, nor helm, nor oar,
  Need I, ask I, to explore
  Thine expanse from shore to shore.

Eager fancy, unconfined,
In a voyage of the mind,
Sweeps along thee like the wind.——
  Where the billows cease to roll,
  Round the silence of the pole,
  Thence set out, my venturous soul!

See, by Greenland cold and wild,
Rocks of ice eternal piled;
Yet the mother loves her child.
  Next on lonely Labrador,
  Let me hear the snowfalls roar,
  Devastating all before.

But a brighter vision breaks
O'er Canadian woods and lakes;
—These my spirit soon forsakes.
  Land of exiled Liberty,
  Where our fathers once were free,
  Brave New England, hail to thee!

Pennsylvania, while thy flood
Waters fields unbought with blood,
Stand for peace as thou hast stood.
  The West Indies I behold,
  Like the Hesperides of old,
  —Trees of life, with fruits of gold!

No—a curse is on the soil;
Bonds and scourges, tears and toil,
Men degrade, and earth despoil.
  Horror-struck, I turn away,
  Coasting down the Mexique bay;
  Slavery there hath lost the day.

South America expands
Mountain-forests, river-lands,
And a nobler race demands;
  And a nobler race arise,
  Stretch their limbs, unclose their eyes,
  Claim the earth, and seek the skies.

Gliding through Magellan's straits,
Where two oceans ope their gates,
What a spectacle awaits!
  The immense Pacific smiles
  Round ten thousand little isles,
  —Haunts of violence and wiles.

But the powers of darkness yield,
For the Cross is in the field,
And the light of life reveal'd.
  Rays from rock to rock it darts,
  Conquers adamantine hearts,
  And immortal bliss imparts.

North and west, receding far
From the evening's downward star,
Now I mount Aurora's car,—
  Pale Siberia's deserts shun,
  From Kamtschatka's headlands run,
  South and east to meet the sun.

Jealous China, strange Japan,
With bewilder'd thought I scan:
—They are but dead seas of man.
  Lo! the eastern Cyclades,
  Phœnix-nests, and halcyon seas;
  But I tarry not with these.

Pass we low New Holland's shoals,
Where no ample river rolls;
—World of undiscover'd souls!

Bring them forth;—'tis Heaven's decree:
Man, assert thy dignity;
Let not brutes look down on thee.

Either India next is seen,
With the Ganges stretch'd between;
Ah! what horrors here have been.
War, disguised as Commerce, came;
Britain, carrying sword and flame,
Won an empire,—lost her name.

By the Gulf of Persia sail,
Where the true-love nightingale
Woos the rose in every vale.
Though Arabia charge the breeze
With the incense of her trees,
On I press o'er southern seas.

Cape of Storms, thy spectre's fled,
And the angel Hope, instead,
Lights from heaven upon thy head.
St Helena's dungeon-keep
Scowls defiance o'er the deep;
There a Hero's relics sleep.

Mammon's plague-ships throng the waves;
Oh! 'twere mercy to the slaves,
Were the maws of sharks their graves.
Hercules, thy pillars stand,
Sentinels of sea and land;
Cloud-capt Atlas towers at hand.

Mark the dens of caitiff Moors;
Ha! the pirates seize their oars;
—Fly the desecrated shores.
Egypt's hieroglyphic realm,
Other floods than Nile's o'erwhelm;
—Slaves turn'd despots hold the helm.

Judah's cities are forlorn,
Lebanon and Carmel shorn,
Zion trampled down with scorn.
Greece, thine ancient lamp is spent;
Thou art thine own monument;
But the sepulchre is rent,

And a wind is on the wing,
At whose breath new heroes spring,
Sages teach, and poets sing.
  Italy, thy beauties shroud
  In a gorgeous evening cloud;
  Thy refulgent head is bowed:

Yet where Roman genius reigns,
Roman blood must warm the veins:
—Look well, tyrants, to your chains.
  Feudal realm of old romance,
  Spain, thy lofty front advance,
  Grasp thy shield, and couch thy lance.

At the fire-flash of thine eye,
Giant Bigotry shall fly;
At thy voice, Oppression die.
  Lusitania, from the dust
  Shake thy locks; thy cause is just;
  Strike for freedom, strike and trust.

France, I hurry from thy shore;
Thou art not the France of yore;
Thou art new-born France no more.
  Sweep by Holland like the blast;
  One quick glance at Denmark cast,
  Sweden, Russia;—all is past.

Elbe nor Weser tempt my stay;
Germany beware the day
When thy schoolmen bear the sway
  Now to thee, to thee I fly,
  Fairest isle beneath the sky
  To my heart as in mine eye!

I have seen them, one by one,
Every shore beneath the sun,
And my voyage now is done.
  While I bid them all be blest,
  Britain, thou'rt my home—my rest:
  —My own land, I love *thee* best.

MONTGOMERY.

EGYPTIAN ANTIQUITIES.

1. *The Pyramids.*—WITH what amazement did we survey the vast surface that was presented to us when we arrived at this artificial mountain, which seemed to reach the clouds! Here and there appeared some Arab guides upon the immense masses above us, like so many pigmies, waiting to show the way to the summit. Already some of our party had begun the ascent, and were pausing at the tremendous depth which they saw below. One of our military companions, after having surmounted the most difficult part of the undertaking, became giddy in consequence of looking down from the elevation he had attained; and, being compelled to abandon the project, he hired an Arab to assist him in effecting his descent. The rest of us, more accustomed to the business of climbing heights, with many a halt for respiration, and many an exclamation of wonder, pursued our way towards the summit. The mode of ascent has been frequently described; and yet from the questions that are often proposed to travellers, it does not appear to be generally understood. The reader may imagine himself to be upon a staircase, every step of which, to a man of middle stature, is nearly breast high; and the breadth of each step is equal to its height; consequently the footing is secure; and although a retrospect, in going up, be sometimes fearful to persons unaccustomed to look down from any considerable elevation, yet there is little danger of falling. In some places, indeed, where the stones are decayed, caution may be required; and an Arab guide is always necessary, to avoid a total interruption; but, upon the whole, the means of ascent are such, that almost every one may accomplish it. Our progress was impeded by other causes. We carried with us a few instruments, such as our boat-compass, a thermometer, a telescope, &c.; these could not be trusted in the hands of the Arabs, and they were liable to be broken every instant. At length we reached the topmost tier, to the great delight and satisfaction of all the party. Here we found a platform, thirty-two feet square, con-

sisting of nine large stones, each of which might weigh about a ton; although they be much inferior in size to some of the stones used in the construction of this pyramid. Travellers of all ages, and of various nations, have here inscribed their names. Some are written in Greek, many in French, a few in Arabic, one or two in English, and others in Latin. We were as desirous as our predecessors to leave a memorial of our arrival; it seemed to be a tribute of thankfulness due for the success of our undertaking; and presently every one of our party was seen busied in adding the inscription of his name.—(*See Illustrations*, *Fig.* 23.)

Dr E. D. Clarke.

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2. *Pompey's Pillar.*—Pompey's Pillar stands near the southern gate of Alexandria. It is composed of red granite. The capital, which is Corinthian, is 9 feet high. The shaft and the upper member of the base are of one piece, 90 feet long, and 9 in diameter. The base, a block of marble, 60 feet in circumference, rests on two layers of stone bound together with lead; which, however, has not prevented the Arabs from forcing out several of them to search for an imaginary treasure. The whole column is 114 feet high. Nothing can equal the majesty of this monument; the beauty of the capital, the length of the shaft, and the extraordinary simplicity of the pedestal, excite the admiration of all travellers. This last has been somewhat damaged by the instruments of travellers curious to possess a relic of antiquity; and one of the volutes of the column was immaturely brought down, a few years ago, by a prank of some English captains, which may be related as an instance of the address and fearlessness of British sailors.

A strange freak entered into the brains of these sons of Neptune to drink a bowl of punch on the top of Pompey's Pillar! To the spot accordingly they went; and many contrivances were proposed to accomplish the desired point. But their labour was vain, until the genius who struck out the frolic happily suggested the means of performing it. A man was despatched to the city for a

paper kite; and the inhabitants, apprized of what was going forward, flocked in crowds to be witnesses of the address and boldness of the English. The kite was flown so directly over the pillar, that when it fell on the other side, the string lodged upon the capital. A two-inch rope was tied to one end of the string, and drawn over the pillar by the end to which the kite was fixed. By this rope one of the seamen ascended to the top; and in less than an hour a kind of shroud was constructed, by which the whole company went up and drank their punch amid the shouts of the astonished multitude.—To the eye below, the capital of the pillar does not appear capable of holding more than one man upon it; but our seamen found it could contain no less than eight persons very conveniently. It is astonishing that no accident befell these madcaps, in a situation so elevated that it would have turned a landman giddy in his sober senses. The only detriment which the pillar received was the loss of the volute before mentioned, which came down with a thundering sound. The discovery which they made amply compensated for this mischief; as, without their evidence, the world would not have known at this hour that there was originally a statue on this pillar, one foot and ankle of which are still remaining.—(*See Illustrations, Fig.* 24.)

Scrap Book.

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3. *Mummy Pits.*—The suffocating air of these tombs is so great as to cause fainting. A vast quantity of dust rises, so fine that it enters into the throat and nostrils, and chokes the nose and mouth to such a degree, that it requires great power of lungs to resist it and the strong effluvia of the mummies. This is not all; the entry or passage, where the bodies are, is roughly cut in the rocks, and in some places there is not more than a vacancy of a foot left, which you must contrive to pass through in a creeping posture like a snail, on pointed and keen stones that cut like glass. After getting through these passages, some of them two or three hundred yards long, you generally find a more commodious place, perhaps high

enough to sit. But what a place of rest! surrounded by heaps of mummies in all directions. The blackness of the wall, the faint light given by the candles or torches for want of air, the different objects that surround you, seeming to converse with each other, and the Arab guides with the candles or torches in their hands, naked and covered with dust, themselves resembling living mummies, absolutely form a scene that cannot be described. After the exertion of entering into such a place, nearly overcome, you seek a resting-place, find one, and contrive to sit; but when your weight bears on the body of an Egyptian, it crushes it like a bandbox. You naturally have recourse to your hands to sustain your weight, but they find no better support; so that you sink altogether among the broken mummies, with a crash of bones, rags, and wooden cases, which raise such a dust as keeps you motionless for a quarter of an hour waiting till it subside again. Once I was conducted from such a place to another resembling it, through a passage of about twenty feet in length, and no wider than what a body could be forced through. It was choked with mummies, and I could not pass without putting my face in contact with that of some decayed Egyptian; but as the passage inclined downwards, my own weight helped me on: however, I could not avoid being covered with bones, legs, arms, and heads, rolling from above.*—(*See Illustrations*, *Fig.* 25.) BELZONI.

ADDRESS TO THE MUMMY IN BELZONI'S EXHIBITION.

AND thou hast walk'd about (how strange a story!)
  In Thebes's streets three thousand years ago,
When the Memnonium was in all its glory,
  And time had not begun to overthrow
Those temples, palaces, and piles stupendous,
Of which the very ruins are tremendous.

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* In addition to many valuable relics, Belzoni found numerous specimens of Egyptian manufactures in these subterraneous abodes; some of them, such as leaf-gold, which he describes as equally thin with our own, evincing no ordinary degree of advancement in the arts.

Speak! for thou long enough hast acted Dummy,
  Thou hast a tongue—come, let us hear its tune;
Thou'rt standing on thy legs above ground, Mummy!
  Revisiting the glimpses of the moon,
Not like thin ghosts or disembodied creatures,
But with thy bones and flesh, and limbs and features.

Tell us—for doubtless thou canst recollect—
  To whom should we assign the Sphinx's fame?
Was Cheops or Cephrenes architect
  Of either Pyramid that bears his name?
Is Pompey's Pillar really a misnomer?
Had Thebes a hundred gates, as sung by Homer?

Perchance that very hand, now pinion'd flat,
  Has hob-a-nobb'd with Pharaoh glass to glass;
Or dropp'd a halfpenny in Homer's hat,
  Or doff'd thine own to let Queen Dido pass,
Or held, by Solomon's own invitation,
A torch at the great Temple's dedication.

I need not ask thee if that hand, when arm'd,
  Has any Roman soldier maul'd and knuckled,
For thou wert dead, and buried, and embalm'd,
  Ere Romulus and Remus had been suckled:—
Antiquity appears to have begun
Long after thy primeval race was run.

Since first thy form was in this box extended,
  We have, above ground, seen some strange mutations;
The Roman empire has begun and ended,
  New worlds have risen—we have lost old nations;
And countless kings have into dust been humbled,
While not a fragment of thy flesh has crumbled.

Didst thou not hear the pother o'er thy head,
  When the great Persian conqueror, Cambyses,
March'd armies o'er thy tomb with thundering tread,
  O'erthrew Osiris, Orus, Apis, Isis,
And shook the Pyramids with fear and wonder,
When the gigantic Memnon fell asunder?

If the tomb's secrets may not be confess'd,
  The nature of thy private life unfold:—

A heart has throbb'd beneath that leathern breast,
And tears adown that dusky cheek have roll'd:—
Have children climb'd those knees and kiss'd that face?
What was thy name and station, age and race?

Statue of flesh—immortal of the dead!
Imperishable type of evanescence!
Posthumous man, who quitt'st thy narrow bed,
And standest undecay'd within our presence,
Thou wilt hear nothing till the Judgment-morning,
When the great trump shall thrill thee with its warning.

Why should this worthless tegument endure,
If its undying guest be lost for ever?
O let us keep the soul embalm'd and pure
In living virtue, that, when both must sever,
Although corruption may our frame consume,
The immortal spirit in the skies may bloom.

HORACE SMITH.

THE WINDS.

WIND is the motion of a stream or current of air. It may be produced by a variety of chemical and meteorological causes; but the most common cause is a partial change of temperature in the atmosphere. When any one part is more heated than the rest, that part is rarefied; the equilibrium is destroyed, and the air in consequence rises. When this happens, there necessarily follows a motion of the surrounding air towards that part, in order to restore it; this spot, therefore, receives wind from every quarter, so that those who live to the north of it experience a north wind, and those to the south a south wind. This motion occurs especially in the torrid zone, where the heat is greatest; the air being more rarefied there than in any other part of the globe, is lighter, and consequently ascends; whilst the air is continually flowing from the poles to restore the equilibrium. This motion of the air would produce a regular and constant north wind to the inhabitants of the northern hemisphere, a south wind to those of the southern hemisphere.

and continual storms at the equator, did not the diurnal rotation of the earth modify it in some degree. The atmosphere accompanies the earth in its diurnal motion, and consequently travels with greater or less velocity as it is nearer the equator, or more distant from it. When, therefore, the air flows from the north or south to restore the atmospherical equilibrium at the equator, this air, not having acquired the velocity of the equatorial regions, cannot keep pace with the earth, which, travelling faster, passes through it; and as the earth moves from west to east, this motion of the earth through the air produces a regular east wind at the equator. The winds from the north and south combine with the easterly wind about the equator, and form what are called the *trade-winds*. The composition of the two winds, north and east, produces a constant north-east wind; and that of the two winds, south and east, a regular south-east wind. These winds extend to about thirty degrees on each side of the equator, the regions farther distant from it experiencing only their respective north and south winds.

There are also periodical trade-winds, called *monsoons*, which change their course every half-year. This variation is produced by the earth's annual course round the sun, when the north pole is inclined towards that luminary one-half of the year, and the south pole the other half. During the summer of the northern hemisphere, the countries of Arabia, Persia, India, and China, are much heated, and reflect great quantities of the sun's rays into the atmosphere, by which it becomes extremely rarefied, and the equilibrium consequently destroyed. In order to restore it, the air from the equatorial southern regions, where it is colder (as well as from the colder northern parts), must necessarily have a motion towards those parts. The current of air from the equatorial regions produces the trade-winds for the first six months in all the seas between the heated continent of Asia and the equator. The other six months, when it is summer in the southern hemisphere, the ocean and countries towards the southern tropic are most heated, and the air

over those parts most rarefied; then the air about the equator alters its course, and flows exactly in an opposite direction. The breaking of the monsoons is the name given by sailors to the shifting of these periodical winds. They do not change their course suddenly, but by degrees, as the sun moves from one hemisphere to the other. This change is usually attended by storms and hurricanes very dangerous for shipping; so that those seas are seldom navigated at the season of the equinox.

These remarks will explain the winds in the torrid zone; but what is it that occasions the great variety of winds which occur in the temperate zones? This question does not admit of a positive answer. This, however, is plain:—that the air, in all climates, will suffer more or less perturbation, according to the situation of the country, the position of mountains, valleys, and a variety of other causes; and that, hence, almost every climate must be liable to variable winds. On the seashore there is generally a gentle sea-breeze setting in on the land on a summer evening, to restore the equilibrium which had been disturbed by reflections from the heated surface of the shore during the day; and when night has cooled the land, and condensed the air, at the approach of morning it flows back towards the sea, producing what is called the land-breeze. All the causes that have the effect of varying the wind cannot be enumerated; but it may be observed in general, that a change in the temperature of a column of air, the transformation of atmospheric vapours into water, their congelation,—in a word, whatever causes a vacuum, a condensation, an expansion, and consequently destroys the equilibrium of the atmosphere,—necessarily produces wind.

It is almost unnecessary to portray the useful and agreeable effects of which the winds are productive. They purify our atmosphere, by keeping up a perpetual agitation in it; they dissipate the miasmata exhaled from marshes and stagnant water; they raise and transport the clouds destined to fertilize the ground by means of rain. Millions of seeds, furnished with their little

pinions, ride upon the wings of the wind, and spread afar the empire of vegetation. The ingenuity of man has made a lever of the winds, which, when, applied to machinery, spares him an immensity of toil. If the ocean is the highway of our globe, winds are the indefatigable coursers which rapidly transport our ships from pole to pole. Considering winds merely in a picturesque point of view, how many enjoyments do they procure to a lover of the great spectacle of nature,—above all, to the inhabitant of mountains! Sometimes they spread over every valley a curtain of clouds, which shows the summits of the far-distant Alps like so many islands scattered on the surface of an ocean; sometimes, partially drawing this curtain aside, they open to us all at once the most astonishing prospects, in which the brightest sunshine forms a happy contrast with the contiguous shades. In the evenings of summer, and still more of autumn, it is the winds which, accumulating and marshalling their long trains of clouds, create and destroy before us those fugitive landscapes, those aërial mountains, which are tinged by the fires of the setting sun.

OPTICAL INSTRUMENTS.—TELESCOPE, MICROSCOPE.

The invention of *optical instruments* is one of the most valuable contributions which individual ingenuity has made to the general welfare. Not to mention *spectacles* (invented, it is said, by a Florentine of the name of Salvino, in the beginning of the 14th century), one of the most beneficial discoveries ever made for a large portion of mankind, let us consider the *telescope* and *microscope.* The son of a spectacle-maker of Middleburg in Holland, happening to amuse himself in his father's shop, by holding two glasses between his finger and his thumb, and varying their distance, perceived the weathercock of the church-spire opposite to him much larger than ordinary, and apparently much nearer, and turned upside down. This new wonder excited the amazement of the father; he adjusted two glasses on a board, rendering them mov-

able at pleasure; and thus formed the first rude imitation of a perspective-glass, by which distant objects are brought near to view. Galileo, a philosopher of Tuscany, hearing of the invention, set his mind to work in order to bring it to perfection. He fixed his glasses at the end of long organ-pipes, and constructed a telescope, which he soon directed to different parts of the surrounding heavens. He discovered four moons revolving round the planet Jupiter—spots on the surface of the sun, and the rotation of that globe around its axis—mountains and valleys in the moon—and numbers of fixed stars where scarcely one was visible to the naked eye. These discoveries were made about the year 1610, a short time after the first invention of the telescope. Since that period this instrument has passed through various degrees of improvement, and, by means of it, celestial wonders have been explored in the distant spaces of the universe, which, in former times, were altogether concealed from mortal view.

The telescope may be considered as a vehicle for conveying us to the distant regions of space. By the aid of Dr Herschel's telescope, which magnifies 6000 times, we can view the magnificent system of the planet Saturn as well as if we had performed a journey 800,000,000 miles in the direction of that globe, which, at the rate of 50 miles an hour, it would require a period of 1800 years to accomplish; by the same instrument we can contemplate the region of the fixed stars, their arrangement into systems, and their immense numbers, with the same amplitude of view as if we had actually taken a flight of 4,000,000,000,000 miles into these unexplored regions, which could not be accomplished in several millions of years, though our motion was as rapid as that of a ball projected from a cannon. This instrument has therefore been justly described, when it has been called "a providential gift bestowed upon mankind, to serve as a temporary substitute for those powers of rapid flight with which seraphim are endowed, and with which man himself may be invested when he arrives at the summit of moral perfection."

Not less wonderful are the discoveries of the *microscope*, an instrument constructed on similar principles, for the purpose of examining minute objects. When and by whom this instrument was invented is not certainly known; though it is believed that Drebell, a Dutchman, who had one in 1621, was either the inventor or an early improver of it. By means of this optical contrivance we perceive a variety of wonders in almost every object in the animal, the vegetable, and the mineral kingdoms. We perceive, for instance, that every particle of matter, however minute, has a determinate form— that the very scales on the skin of a fish are all beautifully interwoven and variegated like pieces of network, which no art can imitate—that the points of the prickles of vegetables, though magnified a thousand times, appear as sharp and well polished as to the naked eye—that every particle of the dust on a butterfly's wing is a beautiful and regularly organized feather—that every hair of our head is a hollow tube, with bulbs and roots, furnished with a variety of threads or filaments—and that the pores in our skin, through which the perspiration flows, are so numerous and minute, that a grain of sand would cover a hundred and twenty-five thousand of them. We perceive animated beings in certain liquids, so small that fifty thousand of them would not equal the size of a mite; and yet each of these creatures is furnished with a mouth, eyes, stomach, blood-vessels, and other organs for the performance of animal functions. In a stagnant pool, which is covered with a greenish scum during the summer months, every drop of the water is found to be a world teeming with thousands of inhabitants. The mouldy substance which usually adheres to damp bodies exhibits a forest of trees and plants, where the branches, leaves, and fruit can be plainly distinguished. In a word, by this admirable instrument we behold the same Almighty hand which rounded the spacious globe on which we live and the huge masses of the planetary orbs, and directs them in their rapid motions through the sky—employed, at the same moment, in rounding and polishing ten thousand minute transparent globes in the eye of a fly, and

boring and arranging veins and arteries, and forming and clasping joints and claws for the movements of a mite?

TIMES AND SEASONS.

THE lark has sung his carol in the sky;
The bees have humm'd their noontide lullaby;
Still in the vale the village-bells ring round,
Still in Llewellyn-hall the jests resound;
For now the caudle-cup is circling there,
Now, glad at heart, the gossips breathe their prayer,
And, crowding, stop the cradle to admire
The babe, the sleeping image of his sire.

A few short years—and then these sounds shall hail
The day again, and gladness fill the vale;
So soon the child a youth, the youth a man,
Eager to run the race his fathers ran:
Then the huge ox shall yield the broad sirloin:
The ale, now brew'd, in floods of amber shine:
And, basking in the chimney's ample blaze,
'Mid many a tale told of his boyish days,
The nurse shall cry, of all her ills beguiled,
"'Twas on these knees he sate so oft and smiled."

And soon again shall music swell the breeze:
Soon, issuing forth, shall glitter through the trees
Vestures of nuptial white; and hymns be sung,
And violets scatter'd round; and old and young,
In every cottage-porch with garlands green,
Stand still to gaze, and gazing bless the scene;
While, her dark eyes declining, by his side
Moves in her virgin veil the gentle bride.

And once, alas! nor in a distant hour,
Another voice shall come from yonder tower;
When in dim chambers long black weeds are seen,
And weepings heard where only joy has been;
When by his children borne, and from his door
Slowly departing to return no more,
He rests in holy earth with them that went before.

RODGERS.

HOW still the morning of the hallow'd day!
Mute is the voice of rural labour, hush'd

The ploughboy's whistle, and the milkmaid's song.
The scythe lies glittering in the dewy wreath
Of tedded grass, mingled with fading flowers,
That yestermorn bloom'd waving in the breeze.
Sounds the most faint attract the ear,—the hum
Of early bee, the trickling of the dew,
The distant bleating midway up the hill.
Calmness sits throned on yon unmoving cloud.
To him who wanders o'er the upland leas,
The blackbird's note comes mellower from the dale;
And sweeter from the sky the gladsome lark
Warbles his heaven-tuned song; the lulling brook
Murmurs more gently down the deep-worn glen;
While from yon lowly roof, whose curling smoke
O'ermounts the mist, is heard, at intervals,
The voice of psalms,—the simple song of praise.

GRAHAME.

CHILD, amidst the flowers at play,
While the red light fades away;
Mother, with thine earnest eye,
Ever following silently;
Father, by the breeze of eve,
Call'd thy harvest-work to leave:
Pray! ere yet the dark hours be,
Lift the heart and bend the knee.

Traveller, in the stranger's land
Far from thine own household band;
Mourner, haunted by the tone
Of a voice from this world gone;
Captive, in whose narrow cell
Sunshine hath not leave to dwell;
Sailor, on the darkening sea—
Lift the heart and bend the knee.

Warrior, that from battle won
Breathest now at set of sun;
Woman, o'er the lowly slain
Weeping on his burial-plain;
Ye that triumph, ye that sigh,
Kindred by one holy tie;
Heaven's first star alike ye see—
Lift the heart and bend the knee. Mrs HEMANS.

———Methinks if ye would know
How visitations of calamity
Affect the pious soul, 'tis shown ye there!
Look yonder at that cloud, which, through the sky,
Sailing alone, doth cross in her career
The rolling moon!—I watch'd it as it came,
And deem'd the deep opaque would blot her beams;
But, melting like a wreath of snow, it hangs
In folds of wavy silver round, and clothes
The orb with richer beauties than her own,
Then passing, leaves her in her light serene!

Southey.

Leaves have their time to fall,
And flowers to wither at the north wind's breath,
And stars to set—but all,
Thou hast *all* seasons for thine own, O Death!

Day is for mortal care,
Eve for glad meetings round the joyous hearth,
Night for the dreams of sleep, the voice of prayer;
But all for thee, thou Mightiest of the Earth!

We know when moons shall wane,
When summer-birds from far shall cross the sea,
When autumn's hue shall tinge the golden grain;
But who shall teach us when to look for thee?

Is it when spring's first gale
Comes forth to whisper where the violets lie?
Is it when roses in our paths grow pale?
They have *one* season—*all* are ours to die!

Thou art where billows foam;
Thou art where music melts upon the air;
Thou art around us in our peaceful home;
And the world calls us forth—and thou art there;

Thou art where friend meets friend,
Beneath the shadow of the elm to rest;
Thou art where foe meets foe, and trumpets rend
The skies, and swords beat down the princely crest!

Mrs Hemans.

SECTION VII.

AQUEOUS VAPOUR.—CLOUDS AND MISTS, RAIN, DEW, SNOW, HAIL.

It has been already mentioned, that water exposed to the air is gradually converted into a state of vapour, which, on account of its specific levity, ascends into the atmosphere. This vapour presents itself in various forms. When the air holds it in solution, it is invisible, just as salt dissolved in water is invisible; but when the vapour condenses, the watery particles become visible either in the form of clouds and mists suspended in the atmosphere, or in that of rain, dew, snow, and hail, falling to the ground.

Clouds and *Mists* differ only in this, that the former float high in the air, whereas the latter extend along near the ground. They are understood to consist of a collection of small vesicles or hollow spheres, and to occupy a sort of intermediate state between water and invisible vapour. The causes that produce these vesicles are not well understood, though change of temperature and electricity have probably the principal share in the transformation. The height of clouds is very various. In ascending to the summit of mountains, the traveller frequently passes through a zone of clouds, and beholds the vesicular vapours of which it is composed stretched under his feet like a vast plain covered with snow; but even on Chimborazo, one of the loftiest peaks of the Andes, there are always to be seen, at an immense height, certain whitish clouds resembling flakes of wool. These clouds, which are perhaps many miles from the surface of the earth, are supposed to owe their elevation to negative electricity repelling them from the ground, in the same way as mists

are supposed to owe their depression to positive electricity attracting them towards it.

Rain falls from the clouds when the vesicular vapour of which they are composed unites into drops. The fall of the drops of rain, after they are formed, is easily accounted for from the attraction of gravity; but the cause of the conversion of vesicular vapour into rain-drops is not better understood than the cause of the conversion of vapour into vesicles, though it is highly probable that electricity is an agent in the one case as well as in the other. If the change be owing to the diminution of this fluid, we have a ready explanation of the well-known fact, that mountainous are the most rainy countries; mountains constituting so many points for drawing off the electric fluid. This supposition is further rendered very probable by the fact, that no rain falls in those regions where thunder is unknown, as in the environs of Lima, and on the coast of Peru. Deluc observed a very elevated cloud descend with rapidity towards the earth, scatter round a violent shower of rain, and then with equal velocity remount to its original height,—a circumstance which seems confirmatory of the same hypothesis.

The quantity of rain that falls in different regions of the globe is very different. It is most abundant within the torrid zone, and decreases in proportion to the distance from the equator. The annual fall at Grenada, in 12° N. lat., is 126 inches; at Calcutta, in 22° N. lat., it is 81 inches; at Rome, in 41° 54′, it is 39 inches; in England 32 inches; and at Petersburg, in lat. 59° 16′, it is only 16 inches. Even in different places in the same country the quantity that falls is different. At London, according to Dalton, it is 20 inches; at Manchester, 36 inches; at Kendal, 53 inches; at Dumfries, 36; at Glasgow, 21; and at Edinburgh, 29; but the most curious fact of all in the natural history of rain is the difference of quantity which is collected at different heights at the same place. In one year a rain-gauge on the top of Westminster Abbey received 12 inches; another on the top of a house in

the vicinity received 18 inches; and a third on the surface of the ground received 22 inches.

Dew, or the moisture insensibly deposited from the atmosphere on the surface of the ground, is a well-known phenomenon. It was long supposed that its precipitation was owing to the cooling of the atmosphere towards evening, which prevented it from retaining so great a quantity of watery vapour in solution as during the heat of the day; but Dr Wells has satisfactorily proved that the deposition of dew is produced by the cooling of the surface of the earth, which, he has shown, takes place previously to the cooling of the atmosphere. The earth is an excellent radiator of caloric, whilst the atmosphere does not possess that property in any sensible degree. Towards evening, therefore, when the solar heat declines, and after sunset, when it entirely ceases, the earth rapidly cools by radiating heat towards the skies, whilst the air has no means of parting with its heat but by coming into contact with the cooled surface of the earth, to which it communicates its caloric. Its solvent power being thus reduced, it is unable to retain so large a portion of watery vapour, and deposites those pearly drops called dew. This view of the matter explains the reason why dew falls more copiously in calm than in stormy weather, and in a clear than in a cloudy atmosphere. Accumulations of moisture in the atmosphere not only prevent the free radiation of the earth towards the upper regions, but themselves radiate towards the earth; whereas, in clear nights, the radiation of the earth passes without obstacle through the atmosphere to the distant regions of space, whence it receives no caloric in exchange. The same principle enables us to explain the reason why a bottle of wine taken fresh from the cellar (in summer particularly) will soon be covered with dew. The bottle being colder than the surrounding air absorbs caloric from it; the moisture therefore which that air contained becomes visible, and forms the dew which is deposited on the bottle. In like manner, in a warm room, or in a close carriage, the inside

of the windows is covered with vapour, because the window, being colder than the breath, deprives it of part of its caloric, and by this means converts it into watery vapour.

Bodies attract dew in proportion as they are good radiators of caloric, as it is this quality which reduces their temperature below that of the atmosphere. Hence we find, that little or no dew is deposited on rocks, sand, or water; while grass and living vegetables, to which it is so highly beneficial, attract it in abundance,—a remarkable instance of the wise and bountiful dispensations of Providence. The same benevolent design we may observe also in the abundance of dew in summer and in hot climates, where its cooling effects are so much required. The more caloric the earth receives during the day, the more it will radiate afterwards, and consequently the more rapidly its temperature will be reduced in the evening, in comparison to that of the atmosphere. In the West Indies, accordingly, where the intense heat of the day is strongly contrasted with the coolness of the evening, the dew is prodigiously abundant. When dew is frozen the moment it falls, it gets the name of *hoar-frost.*

Snow is another of the forms which the vapours of the atmosphere assume. It consists of aqueous vapour congealed, either while falling, or when in the air previous to falling. The first crystals, produced at a great height in the atmosphere, determine, as they descend, the crystallization of aqueous particles, which, without their presence, the surrounding air would retain in a state of solution. The result is the formation of hexagonal darts, or stars of six rays, when the weather is sufficiently calm, and the temperature not too high to deform the crystals by melting off their angles; but when the atmosphere is agitated, and the snow falls from a great height, the crystals clash together, unite in groups, and form irregular flakes.

Hail, according to all appearance, is a species of snow,

or of snowy rain, which has undergone a variety of congelations and superficial meltings in its passage through different zones of the atmosphere, of different temperatures. Its formation evidently depends upon electricity. It is by an electrical apparatus that we can produce artificial hail; and it is well known that volcanic eruptions are often followed by the fall of hailstones of enormous size.

Such are the principal circumstances which are supposed to concur in the formation of aqueous meteors. Their beneficial influence upon the earth is a point more easy to determine. We observe all nature languish when the atmosphere retains for too long a time the moisture arising from the earth. Plants fade and droop; animals feel their strength failing them; man himself, breathing nothing but dust, can with difficulty procure shelter from the sultry heat, by which his frame is parched and overpowered; but scarcely have the waters of heaven descended from the clouds, when all living beings begin to revive; the fields resume their green attire, the flowers their lively tints, animals the sportive freedom of their motions, and the elements of the air their healthful equilibrium. Snow itself, whose very name alarms the natives of the tropics, is productive of real advantages in the economy of nature; it secures the roots of plants against the effects of intense cold; it serves gently to moisten those lands from which, owing to their local situation, the rain is too soon carried off; and it paves for the inhabitant of the north commodious and agreeable roads, along which he gaily skims in his light and nimble sledge. Hail alone, of all the aqueous meteors, never appears but as a harbinger of distress. Birds and quadrupeds instinctively conceal themselves as soon as they have any presentiment of its coming. Man can neither foresee its approach, nor arrest its ravages; he has been able to ward off the thunderbolts of the sky, but he sees the hail destroy his corn, break his fruit-trees, and shatter the very house where he dwells, without being able to prevent it.

ASPIRATIONS OF YOUTH.

HIGHER, higher will we climb
  Up the mount of glory,
That our names may live through time
  In our country's story;
Happy, when her welfare calls,
He who conquers, he who falls.

Deeper, deeper let us toil
  In the mines of knowledge;
Nature's wealth and Learning's spoil
  Win from school and college;
Delve we there for richer gems
Than the stars of diadems.

Onward, onward may we press
  Through the path of duty;
Virtue is true happiness,
  Excellence true beauty:
Minds are of celestial birth,
Make we then a heaven of earth.

Closer, closer let us knit
  Hearts and hands together,
Where our fireside-comforts sit
  In the wildest weather;—
O, they wander wide who roam
For the joys of life from home!

MONTGOMERY.

THE BETTER LAND.

"I HEAR thee speak of the better land;
Thou callest its children a happy band:
Mother! O where is that radiant shore?—
Shall we not seek it, and weep no more?—
Is it where the flower of the orange blows,
And the fire-flies dance through the myrtle boughs?"
    "Not there, not there, my child!"

"Is it where the feathery palm-trees rise,
And the date grows ripe under sunny skies?—

Or 'midst the green islands on glittering seas,
Where fragrant forests perfume the breeze,
And strange bright birds, on their starry wings,
Bear the rich hues of all glorious things?"
"Not there, not there, my child!"

"Is it far away in some region old,
Where the rivers wander o'er sands of gold?
Where the burning rays of the ruby shine,
And the diamond lights up the secret mine,
And the pearl gleams forth from the coral strand,
Is it there, sweet mother, that better land?"
"Not there, not there, my child!—

"Eye hath not seen it, my gentle boy!
Ear hath not heard its deep songs of joy;
Dreams cannot picture a world so fair—
Sorrow and death may not enter there:
Time doth not breathe on its fadeless bloom;
For beyond the clouds, and beyond the tomb,
It is there, it is there, my child!"

Mrs Hemans.

THE BRITISH CONSTITUTION.

In England the supreme government,—that is, the power of making and enforcing laws,—is divided into two branches; the one *legislative*, consisting of king, lords, and commons; the other *executive*, consisting of the king alone.

The executive or regal office is hereditary on certain conditions; but the right of inheritance may be changed or limited by act of parliament. The principal duty of the king is to govern the people according to the laws; "but although the king," says Lord Bacon, "is the fountain of justice, and is intrusted with the whole executive power of the law, yet he hath no power to change or alter the laws which have been received and established in these kingdoms, and are the birthright of every subject; for it is by those very laws that he is to govern." The king owns no superior but God and the laws. It is a

maxim of the constitution, that the king in his political capacity can do *no wrong*, because he acts only by officers responsible to the law. The king *never dies;* that is, the executive authority never ceases to exist. The king is head of the English Church, but he cannot alter the established religion. He is also generalissimo of all the forces, but he cannot raise an army without the consent of parliament, nor can he maintain it without that consent being renewed from year to year. He has the power of coining money, but he cannot alter the standard. He is the sole representative of his people with foreign states, having the power of sending ambassadors, concluding treaties of alliance, and making peace or war. The king has the power of summoning, proroguing, or dissolving the parliament; but he is bound to summon a new parliament at least every seven years. He is also bound to administer justice in the established course in his courts of law, not as a free gift, but as the due of his people. The king is the fountain of mercy; he alone can pardon all public offences, either absolutely or conditionally; and of honour, as the constitution has intrusted him with the sole power of conferring titles, dignities, and honours. He is also intrusted with the immense patronage of the church, the army, the navy, the excise, and the colonies. As first magistrate of a great and free people, he is invested with many other splendid marks of regal dignity and pre-eminence, all intended by the constitution to be employed for the good of the people.

The *legislative* authority is vested in a parliament, consisting of the king, the lords spiritual and temporal, and the commons. The House of Lords consists of the two archbishops and twenty-four bishops, and of all the peers of the realm who are entitled to a seat either by inheritance, creation, or election. The House of Commons consists of six hundred and fifty-eight persons, who are returned by the counties, cities, and boroughs, possessing the right of election. Of these, five hundred are returned by England, one hundred and five by Ireland, and fifty three by Scotland. Though delegated by partic-

ular places, they are bound as members of parliament to act for the general good of the country. Their principal duties are to check and reform abuses of the administration—to redress public and private grievances—to watch over the public expenditure—to enforce by their power of inquiry and impeachment a pure administration of justice in all departments—to assist in framing wise laws,—and, finally, to preserve and promote, by every constitutional means, the freedom and prosperity of the great body of the people. The powers and privileges of this part of the legislature are commensurate to its great importance in the government. The Commons possess the sinews of war; they are the keepers of the public purse; all grants, subsidies, and taxes, must originate with them; for it is a constitutional maxim, that taxation and representation go hand in hand; and that the people only have a right to tax themselves. By the power of withholding supplies, they have a strong control over the executive; and by the constitution they enjoy all the privileges necessary to their dignity and independence, and the unbiassed discharge of their high functions. Though new laws may be proposed by any member of either house, the consent of all the three constituent parts of the legislature is necessary to make them binding on the subject: and though any part of the legislature may, by withholding its consent, prevent the enactment of a law, it requires the agreement of all the three to repeal an existing statute.

"Thus," as observed by Blackstone, "the true excellence of the British government consists in all its parts forming a mutual check upon each other. The legislature cannot abridge the executive power of any rights which it now has by law, without its own consent. The people are a check upon the nobility, and the nobility are a check upon the people, by the mutual privilege of rejecting what the other has resolved; while the king is a check upon both; which preserves the executive power from encroachment. And this very executive power is again checked, and kept within due bounds, by the two

houses, through the privilege they have of inquiring into, impeaching, and punishing the conduct, not indeed of the king (which would destroy his constitutional independence), but, which is more beneficial to the public, of his evil and pernicious counsellors."

The same laws that secure to the king his crown and prerogative, secure to the meanest subject those rights which are emphatically styled the birthright of Britons. These are principally the right of personal *security*, of personal *liberty*, and of private *property*. They are asserted, first, by the Great Charter obtained, sword in hand, from King John, and afterwards confirmed in parliament by Henry III. Next, by a multitude of corroborating statutes, and, after a long interval, by the Petition of Right, the Habeas Corpus Act, and the Bill of Rights. And, lastly, these liberties were again asserted in the same act (the Act of Settlement) that limits the crown to the present royal family. The Great Charter, declaratory of these rights, states,—"That no freeman shall be taken or imprisoned but by the lawful judgment of his equals, or the law of the land;" and the Petition of Rights,—"That no person shall be imprisoned or detained without cause shown, to which he may answer according to law." JOHNSTONE'S *Collection.*

COMPOUND BODIES CONTINUED.*—ALKALIES, EARTHS, ACIDS.

THE first class of compounds that present themselves to our notice, in our gradual ascent to the most complicated combinations, are bodies composed of only two principles.

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* *Chemical Nomenclature.*—Before proceeding to study the compound bodies, it is necessary to have some idea of the nomenclature of chemistry. It is very simple and ingenious in its construction. Compounds, of which oxygen forms a part, are called *acids* or *oxides*, according as they do or do not possess acidity. An oxide of iron or copper signifies a combination of those metals with oxygen, which has no acid properties. The name of an acid is derived from the substance acidified by the oxygen, to which is added the termination in *ic*. Thus sulphur*ic* and carbon*ic* acids signify acid compounds of

The sulphurets, phosphurets, carburets, &c. are of this description; but the most numerous and important of these compounds are the combinations of oxygen with the various simple substances with which it has a tendency to unite. Of this class are the *alkalies*, the *earths*, and the *acids*, which we shall successively examine.

Alkalies.—THE alkalies are three in number, viz. *potash*, *soda*, and *ammonia*. The first two are called *fixed alkalies*, because they exist in a solid state at the temperature of the atmosphere, and require a great heat to volatilize them. They consist of metallic bases combined with oxygen. The third, ammonia, is called *volatile alkali*, because its natural form is that of gas. It consists of hydrogen and nitrogen. The general properties of alkalies are, an acrid burning taste, a pungent smell, and a caustic action on the skin and flesh; they change blue vegetable infusions to green, and have

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sulphur and carbon with oxygen gas. If sulphur or any other body forms two acids, that which contains the least quantity of oxygen is made to terminate in *ous*, as sulphur*ous* acid. The termination in *uret* denotes combinations of the simple non-metallic substances either with one another, with a metal, or with a metallic oxide. Sulph*uret* and carb*uret* of iron, for example, signify compounds of sulphur and carbon with iron. The different oxides or sulphurets of the same substance were formerly distinguished from one another by some epithet, which is commonly derived from the colour of the compound, such as the black and red oxides of iron, the black and red sulphurets of mercury; but it is now more customary to distinguish degrees of oxidation by the use of derivatives from the Greek. *Prot*oxide signifies the first degree of oxidation, *deut*oxide the second, *trit*oxide the third, and *per*oxide the highest. The sulphurets, carburets, &c. of the same substance are designated in a similar way. The combinations of acids with alkalies, earths, or metallic oxides, are termed salts, the names of which are so contrived as to indicate the substances contained in them. If the acidified substance contains a maximum of oxygen, the name of the salt terminates in *ate;* if a minimum, the termination in *ite* is employed. Thus, the sulph*ate*, phosph*ate*, and arseni*ate* of potash, are salts of sulphur*ic*, phosphor*ic*, and arsen*ic* acids; while the terms sulph*ite*, phosph*ite*, and arsen*ite*, of potash denote combinations of that alkali with the sulphur*ous*, phosphor*ous*, and arseni*ous* acids.

a very great tendency to unite with acids, with which they form *neutral salts.* *Potash*, which, when pure, is a dry white powder, difficult to preserve in its pulverized state from its extreme attraction for the moisture of the atmosphere, exists, in an impure state, in nature, in a variety of forms and combinations. It is most commonly obtained from the ashes of vegetables, which are the residue that remains after all the other parts are volatilized by combustion; and it derives its name from the pots in which the vegetable used formerly to be burnt. *Pearl-ash*, which is of great efficacy in taking out grease from linen, &c. is potash in a very impure state; and potash itself combines readily with oil or fat, and forms the well-known compound, *soap*. Another remarkable property of potash is the formation of *glass*, by its fusion with silicious earth,—a substance very abundant in sand and flint. Thus, the same substance which converts transparent oil into such an opaque body as soap, transforms the opaque body, sand, into transparent glass! In combination with nitric acid it forms *saltpetre* (nitrate of potash). *Soda* has so great a resemblance to potash, that the two can scarcely be distinguished, except by the difference of the salts which they form with acids. The great source of this alkali is the sea, where, combined with a peculiar acid, it forms the salt with which the waters of the ocean are so strongly impregnated; but the usual mode of procuring it is by the combustion of marine vegetables in a manner analogous to that in which potash is obtained. In common with the latter it also forms soap and glass. It derives its name from a plant called by us *soda*, and by the Arabs *kali*, which affords it in great abundance. *Kali* has indeed given its name to the alkalies in general. *Ammonia*—well known under the name of *hartshorn*—is most commonly extracted from a compound body called *sal-ammoniac* (muriate of ammonia), which was formerly imported from Ammonia, a region of Libya, whence its name.

Earths.—The common earths are nine in number, *Silex*,

Alumina; *Baryta*, *Lime*, *Magnesia*, *Strontia*, *Yttria*, *Glucina*, *Zirconia*. One of the greatest of modern chemical discoveries is, that these earths, instead of being, as was formerly supposed, simple bodies, are composed of metallic bases combined with oxygen. You must not confine your idea of earths to the formation of soil; for rock, marble, chalk, slate, sand, flint, and all kinds of stones, from the precious jewels to the commonest pebbles — in a word, all the immense variety of mineral products—may be referred to some of these earths, either in a simple state, or combined the one with the other, or blended with other ingredients. Precious stones composed of earth!—It is not more extraordinary than that the most precious of all jewels, diamonds, should be composed of charcoal. The earths are incombustible, though good radiators of caloric (hence the great heat of a turf-fire); and they are all more or less endowed with alkaline properties.

Acids.—An acid is commonly regarded as a substance which has a sour taste, reddens litmus paper, and neutralizes alkalies. But, as some acids are insoluble, and in consequence of their insolubility, do not possess the first two properties, it is more correct to define an acid to be a compound which is capable of uniting in definite proportions with alkaline bases to form salts, and which, when liquid or in a state of solution, has either a sour taste, or reddens litmus paper. The other general properties of acids are, that they combine with water in every proportion, with a condensation of volume, and an evolution of heat,—that they are volatilized or decomposed at a moderate heat,—and that they change the blue, green, and purple colours of vegetables to a bright red. The principal acids procurable from inorganic nature are those formed by the combination of oxygen with nitrogen, carbon, and sulphur. *Nitric acid*, formerly called aquafortis, is composed of nitrogen and oxygen. It is, when pure, about one-half denser than water, and colourless. It is poisonous. It is eminently corrosive;

and it is of considerable use in the arts; being employed for etching on copper, in dyeing, in metallurgy, in assaying, and in medical preparations. It is also of importance in chemical processes, on account of the facility with which it dissolves metals, by first parting with a part of its oxygen to them, and then attacking the oxides. *Carbonic acid* is found in a gaseous state, though it is capable of being absorbed by water, and thus forming a weak acid. It is very abundant in nature. It composes 44 per cent. of the weight of all limestone, chalk, marble, &c. It is emitted by animals in respiration; it is generated in all the spontaneous changes to which dead animal and vegetable matters are subject; and it is always present in the atmosphere, as may be proved by exposing lime-water in an open vessel to the air, when its surface will be covered with a pellicle, which is carbonate of lime. It extinguishes flame and destroys animal life. Being much denser than common air, it remains at the bottom, if it is formed in low confined places, as old wells, mines, &c., and forms an atmosphere called *choke-damp*, which is fatal to any animals that are placed in it. Water and other liquids, which have been charged with it under great pressure, lose the greater part of it when the pressure is removed; and the effervescence which takes place on opening a bottle of soda-water, ginger-beer, cider, or brisk champagne, is owing to its escape. Indeed, the agreeable pungency of beer, porter, and ale, is in a great measure owing to the presence of carbonic acid, by the loss of which, on exposure to the air, they become stale. *Sulphuric acid*, formerly called oil of vitriol, does not occur free in nature, except occasionally in the neighbourhood of volcanoes; but in combination, particularly with lime and baryta, it is very abundant. It is one of the strongest acids with which chemists are acquainted. When undiluted it is powerfully corrosive; it decomposes all animal and vegetable substances, causing deposition of carbon and formation of water. It has a very great affinity for water; and its combination with it takes place with the production of an intense

heat. By its attraction for water, it causes the sudden liquefaction of snow; and if mixed with it in due proportions, an intense degree of cold is generated. It absorbs watery vapour with avidity from the air, and on this account is employed in the process for freezing water by its own evaporation. Indeed, the operation of sulphuric acid in destroying the texture of the skin, in forming ethers, and in decomposing organic substances in general, seems dependent on its affinity for water.

WONDERS OF CIVILISATION.

THE condition of the present inhabitants of this country is very different from that of their forefathers. These, generally divided into small states or societies, had few relations of amity with surrounding tribes, and their thoughts and interests were confined very much within their own little territories and rude habits. Now, however, every one sees himself a member of one vast civilized society which covers the face of the earth, and no part of the earth is indifferent to him. In England, a man of small fortune may cast his regards around him, and say with truth and exultation,—" I am lodged in a house that affords me conveniences and comforts which even a king could not command some centuries ago. There are ships crossing the seas in every direction, to bring what is useful to me from all parts of the earth. In China, men are gathering the tea-leaf for me; in America, they are planting cotton for me; in the West India islands, they are preparing my sugar and my coffee; in Italy, they are feeding silk-worms for me; in Saxony, they are shearing the sheep to make me clothing; at home, powerful steam-engines are spinning and weaving for me, and making cutlery for me, and pumping the mines that minerals useful to me may be procured. My patrimony was small, yet I have carriages running day and night on all the roads to carry my correspondence; I have roads, and canals, and bridges, to bear the coal for my winter fire; nay, I have protecting

fleets and armies around my happy country, to secure my enjoyments and repose. Then I have editors and printers who daily send me an account of what is going on throughout the world, among all these people who serve me, and in a corner of my house I have *books*, the miracle of all my possessions, more wonderful than the wishing-cap of the Arabian tales; for they transport me instantly, not only to all places, but to all times. By my books I can conjure up before me, to vivid existence, all the great and good men of antiquity; and for my individual satisfaction, I can make them act over again the most renowned of their exploits; the orators declaim for me; the historians recite; the poets sing; in a word, from the equator to the pole, and from the beginning of time until now, by my books I can be where I please."—This picture is not overcharged, and might be much extended; such being the miracle of God's goodness and providence, that each individual of the civilized millions that cover the earth may have nearly the same enjoyments as if he were the single lord of all. ARNOTT.

OBSERVE the accommodation of the most common artificer or day-labourer in a civilized country, and you will perceive that the number of people, whose industry has been employed in procuring him this accommodation, exceeds all computation. The woollen coat, for example, which covers him, coarse and rough as it may appear, is the produce of the joint labour of a great multitude of workmen. The shepherd, the sorter of the wool, the wool-comber, the dyer, the spinner, the weaver, the fuller, with many others, must all join their different arts, in order to complete even this homely production. How many merchants and carriers besides must have been employed in transporting the materials from some of those workmen to others! How much commerce and navigation in particular; how many ship-builders, sailmakers, rope-makers, must have been employed in order to bring together the different drugs made use of by the

dyer, which often come from the remotest corners of the world! What a variety of labour, too, is necessary in order to produce the tools of the meanest of these workmen! To say nothing of such complicated machines as the ship of the sailor, the mill of the fuller, or even the loom of the weaver, let us consider only what a variety of labour is requisite in order to form that very simple machine, the shears with which the shepherd clips the wool. The miner, the builder of the furnace for smelting the ore, the feller of the timber, the burner of the charcoal to be made use of in the smelting-house, the brickmaker, the bricklayer, the workmen who attend the furnace, the millwright, the forger, the smith, must all of them join their different arts in order to produce them. Were we to examine, in the same manner, all the different parts of his dress and household furniture; the coarse linen shirt which he wears next his skin, the shoes which cover his feet, the bed which he lies on, and all the different parts which compose it, the kitchen-grate at which he prepares his victuals, the coals which he makes use of for that purpose, dug from the bowels of the earth, and brought to him perhaps by a long sea and a long land carriage, all the other utensils of his kitchen, all the furniture of his table, the knives and forks, the earthen or pewter plates upon which he serves up and divides his victuals, the different hands employed in preparing his bread and his beer, the glass window which lets in the heat and the light, and keeps out the wind and the rain, with all the knowledge and art requisite for preparing that beautiful and happy invention, without which these northern parts of the world could scarce have afforded a very comfortable habitation, together with the tools of all the different workmen employed in producing those different conveniences; if we examine all those things, and consider what a variety of labour is employed about each of them, we shall be sensible, that, without the assistance and co-operation of many thousands, the very meanest person in a civilized country could not be provided, even according

to, what we very falsely imagine, the easy and simple manner in which he is usually accommodated.

ADAM SMITH.

THE GRAVES OF A HOUSEHOLD.

THEY grew in beauty, side by side,
They fill'd one home with glee;—
Their graves are sever'd, far and wide,
By mount, and stream, and sea.
The same fond mother bent at night
O'er each fair sleeping brow;
She had each folded flower in sight,—
Where are those dreamers now?

One, 'midst the forests of the West,
By a dark stream is laid,—
The Indian knows his place of rest,
Far in the cedar shade.
The sea, the blue lone sea, hath one,
He lies where pearls lie deep:
He was the loved of all, yet none
O'er his low bed may weep.

One sleeps where southern vines are drest
Above the noble slain:
He wrapt his colours round his breast,
On a blood-red field of Spain.
And one—o'er her the myrtle showers
Its leaves, by soft winds fann'd;
She faded 'midst Italian flowers,—
The last of that bright band.

And parted thus they rest, who play'd
Beneath the same green tree;
Whose voices mingled as they pray'd
Around one parent knee!
They that with smiles lit up the hall,
And cheer'd with song the hearth,—
Alas! for love, if thou wert all,
And nought beyond, oh earth! MRS HEMANS.

COMPLAINT OF THE DYING YEAR.

"I AM the son of old Father *Time*, and the last of a numerous progeny; for he has had upwards of five thousand of us; but it has ever been his fate to see one child expire before another was born. It is the opinion of some, that his own constitution is beginning to break up, and that when he has given birth to a hundred or two more of us, his family will be complete, and then he himself will be no more." Thus the old year began his complaint. He then called for his account-book, and turned over the pages with a sorrowful eye. He has kept, it appears, an accurate account of the moments, minutes, hours, and months which he has issued, and subjoined, in some places, memorandums of the uses to which they have been applied, and of the losses he has sustained. These particulars it would be tedious to detail; but we must notice one circumstance: upon turning to a certain page in his accounts, the old man was much affected, and the tears streamed down his furrowed cheeks as he examined it. This was the register of the fifty-two Sundays which he had issued; and which, of all the wealth he had to dispose of, has been, it appears, the most scandalously wasted. "These," said he, "were my most precious gifts. Alas! how lightly have they been esteemed!

"I feel, however," said he, "more pity than indignation towards these offenders, since they were far greater enemies to themselves than to me. But there are a few outrageous ones, by whom I have been defrauded of so much of my substance, that it is difficult to think of them with patience, particularly that notorious thief *Procrastination*, of whom everybody has heard, and who is well known to have wronged my venerable father of much of his property. There are also three noted ruffians, *Sleep*, *Sloth*, and *Pleasure*, from whom I have suffered much; besides a certain busy-body called *Dress*, who, under pretence of making the most of me, and taking great care of me, steals away more of my gifts than any two of them.

"As for me, all must acknowledge that I have performed my part towards my friends and foes. I have fulfilled my utmost promise, and been more bountiful than many of my predecessors. My twelve fair children have, each in their turn, aided my exertions; and their various tastes and dispositions have all conduced to the general good. Mild *February*, who sprinkled the naked boughs with delicate buds, and brought her wonted offering of early flowers, was not of more essential service than that rude blustering boy, *March*, who, though violent in his temper, was well-intentioned and useful. *April*, a gentle, tender-hearted girl, wept for his loss, yet cheered me with many a smile. *June* came crowned with roses, and sparkling in sunbeams, and laid up a store of costly ornaments for her luxuriant successors. But I cannot stop to enumerate the good qualities and graces of all my children. You, my poor *December*, dark in your complexion, and cold in your temper, greatly resemble my first-born *January*, with this difference, that he was most prone to anticipation, and you to reflection.

"It is very likely that, at least after my decease, many may reflect upon themselves for their misconduct towards me. To such I would leave it as my dying injunction, not to waste time in unavailing regret: all their wishes and repentance will not recall me to life. I would rather earnestly recommend to their regard my youthful successor, whose appearance is shortly expected. I cannot hope to survive long enough to introduce him; but I would fain hope that he will meet with a favourable reception; and that, in addition to the flattering honours which greeted my birth, and the fair promises which deceived my hopes, more diligent exertion and more persevering efforts may be expected. Let it be remembered that one honest endeavour is worth ten fair promises."

JANE TAYLOR.

ADDRESS TO A STEAM-BOAT.

FREIGHTED with passengers of every sort,
A motley throng, thou leav'st the busy port.

Thy long and ample deck, where scatter'd lie
Baskets and cloaks, and shawls of scarlet dye;
Where dogs and children through the crowd are straying,
And, on the bench apart, the fiddler playing,
While matron dames to tressell'd seats repair,—
Seems on the gleamy waves a floating fair.

Its dark form on the sky's pale azure cast,
Towers from this clustering group thy pillar'd mast:
The dense smoke issuing from its narrow vent
Is to the air in curly volumes sent,
Which, coiling and uncoiling on the wind,
Trails like a writhing serpent far behind.
Beneath, as each merged wheel its motion plies,
On either side the white churn'd waters rise,
And, newly parted from the noisy fray,
Track with light ridgy foam the recent way;
Then far diverged, in many a welting line
Of lustre, on the distant surface shine.

Thou holdst thy course in independent pride;
No leave askst thou of either wind or tide;
To whate'er point the breeze, inconstant, veer,
Still doth thy careless helmsman onward steer,
As if the stroke of some magician's wand
Had lent thee power the ocean to command.

Yet, ne'ertheless, whate'er we owe to thee,
Rover at will on river, lake, and sea,
Dearer to fancy, to the eye more fair,
Are the light skiffs, that, to the breezy air,
Unfurl their swelling sails of snowy hue
Upon the moving lap of ocean blue:
As the proud swan on summer lake displays,
With plumage brightening in the morning rays,
Her fair pavilion of erected wings,—
They change, and veer, and turn like living things.

In very truth, compared to these thou art
A daily labourer, a mechanic swart:
Beholding thee, the great of other days,
And modern men with all their alter'd ways,
Across my mind with hasty transit gleam,
Like fleeting shadows of a feverish dream:

Fitful I gaze, with adverse humours teased,
Half sad, half proud, half angry, and half pleased.

JOANNA BAILLIE.

THE ASSAULT.

'TIS the morn, but dim and dark.
Whither flies the silent lark?
Whither shrinks the clouded sun?
Is the day indeed begun?
Nature's eye is melancholy
O'er the city high and holy:
But without there is a din
Should arouse the saints within,
And revive the heroic ashes
Round which yellow Tiber dashes.
Oh ye seven hills! awaken,
Ere your very base be shaken!

Hearken to the steady stamp!
Mars is in their every tramp!
Not a step is out of tune,
As the tides obey the moon!
On they march, though to self-slaughter,
Regular as rolling water,
Whose high waves o'ersweep the border
Of huge moles, but keep their order,
Breaking only rank by rank.
Hearken to the armour's clank!

Look upon the bristling wall,
Mann'd without an interval!
Round and round, and tier on tier,
Cannon's black mouth, shining spear,
Lit match, bell-mouth'd musquetoon,
Gaping to be murderous soon;
All the warlike gear of old,
Mix'd with what we now behold,
In this strife 'twixt old and new,
Gather like a locusts' crew.

Near—and near—and nearer still,
As the earthquake saps the hill,

First with trembling, hollow motion,
Like a scarce-awaken'd ocean,
Then with stronger shock and louder,
Till the rocks are crush'd to powder,—
Onward sweep the varied nations!
Famine long hath dealt their rations.
To the wall, with hate and hunger,
Numerous as wolves, and stronger,
On they sweep. Oh! glorious city,
Must thou be a theme for pity?
Fight, like your first sire, each Roman!
Alaric was a gentle foeman,
Match'd with Bourbon's black banditti!
Rouse thee, thou eternal city;
Rouse thee! Rather give the torch
With thy own hand to thy porch,
Than behold such hosts pollute
Your worst dwelling with their foot.

Now they reach thee in their anger:
Fire and smoke and hellish clangour
Are around thee, thou world's wonder!
Death is in thy walls and under.
Now the meeting steel first clashes,
Downward then the ladder crashes,
With its iron load all gleaming,
Lying at its foot blaspheming!
Up again! for every warrior
Slain, another climbs the barrier.
Thicker grows the strife: thy ditches
Europe's mingling gore enriches.
Rome! although thy wall may perish,
Such manure thy fields will cherish,
Making gay the harvest-home;
But thy hearths, alas! oh, Rome!
Yet be Rome amidst thine anguish,
Fight as thou wast wont to vanquish!—
Let each breathing heart dilated
Turn, as doth the lion baited!
Rome be crush'd to one wide tomb,
But be still the Roman's Rome!

BYRON.

THE ANIMAL ECONOMY.—MAMMALIA, BIRDS.

THE *teeth* of mammiferous animals are deserving of particular attention, because, according to the numbers, form, and disposition of these, the various orders of quadrupeds have been arranged. In most animals of this class they are used, not only for the mastication of food, but as weapons of offence. They are inserted in two movable bones, called jaws. The front teeth, the office of which is to cut, are wedge-shaped, and so placed that, in action, their sharp edges are brought into contact. On each side of the front teeth are the canine teeth or tusks, which are larger, of a conical shape, and used for tearing the food. The teeth at the back of the jaw, between which the food is masticated, are called grinders. In animals which live on vegetables, these are flattened at the top; but in carnivorous animals, their upper surfaces are furnished with sharp and conically pointed protuberances.

The internal structure of mammalia is very admirable. The blood flows through the body from its reservoir the heart, by a series of vessels called arteries, and returns by another series denominated veins. During the circulation, various fluids, called secretions, are separated from the blood, and are carried through little vessels to be lodged in appropriate reservoirs. These fluids are adapted to various purposes in the system. Into the lungs the atmospheric air is inspired from the mouth; and in them the vital air and the matter of heat are separated; the former being necessary for the maintenance of life, and the latter for keeping up the fluidity of the blood. The mephitic air which remains, after the decomposition, is expired. The act of drawing in the atmospheric air, separating the vital air and matter of heat, and ejecting the mephitic air, is called *respiration.* In *digestion*, the juices fitted to nourish the body are separated from the less useful parts of the food. Reduced to a pulp by means of the teeth and saliva, these pass through a canal to a large reservoir called the stomach, in which the aliment, penetrated and further dissolved

by new juices, undergoes a trituration or kind of grinding, and is separated into nutritive juices, which, on their union, are denominated *chyle.* These juices are then taken up by little vessels called lacteals, and converted into new blood and flesh.

The bodies of all mammiferous animals are supported by a frame of bones, called a *skeleton.* To these bones are attached the muscles or flesh, assemblages of fibres held together by membranes, and terminating in a kind of cords termed tendons. The muscles, when excited, produce motion in the different parts of the body; and it is their action which gives to all animals the power of changing their place, and of performing the various movements which are necessary to them. Sensation is supposed to arise from an irritation taking place on the ends of certain chords, called *nerves*, which are connected with the spinal marrow and the brain. This is a part of the subject, however, on which science is able to shed but a feeble light.*—(*See Illustrations*, *Fig.* 26.)

No division of the animal world furnishes more striking evidences of Supreme Wisdom than that which includes the different feathered tribes. Their structure and habits of life are wonderfully adapted to the various functions they have to perform. Their feathers form an

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* Mammalia have been divided into seven orders; into, 1. *Primates*, which have four front teeth in each jaw, and one canine tooth on each side in both jaws. 2. *Bruta*, which have no front teeth. 3. *Ferae*, which have six front teeth in each jaw, and one canine tooth on each side in both jaws. 4. *Glires*, which have two long front teeth in each jaw, and no canine teeth. 5. *Pecora*, which have no front teeth in the upper jaw, and have cloven hoofs on their feet. 6. *Belluæ*, which have obtuse front teeth in each jaw, and undivided hoofs on their feet. And, 7. *Cete*, or whales, which have fins instead of feet, breathing-holes on the front and upper part of the skull, and flat horizontal tails. Apes and bats are instances of the *first* order; the rhinoceros and elephant of the *second;* dogs, cats, otters, bears, of the *third;* beavers, squirrels, hares, of the *fourth;* goats, sheep, oxen, and camels, of the *fifth;* horses, hogs, of the *sixth;* and whales and dolphins of the *seventh.*

envelope for their bodies, which combines in a remarkable manner the apparently incompatible properties of lightness and warmth; and they are so disposed, one above the other, and from the forepart backward, that they present the least possible resistance to the air. For this purpose also their head is small, their bill wedge-shaped, their neck long and movable in all directions, their body sharp on the under-side and flat on the back, and their bones hollow and comparatively light. For the purpose of giving warmth to the body, a short soft down fills up all the vacant spaces between the shafts of the feathers.

But these indications of supreme wisdom are not confined to the general structure of birds. They may be seen in every part of that structure, even the most minute. They may be seen in the supply of unctuous matter which is given for defending the feathers from the moisture of the atmosphere,—a supply which invariably accords with the necessities of the different species, those having most that reside constantly in the open air, and those that live principally under cover having a more scanty share.* They may be seen in the movable membrane which defends the eye from injury when passing through hedges and thickets,—a membrane which is semi-transparent, and which the bird can move at pleasure. They may be seen in the singular contrivance by which the bird is enabled to change the shape of the eye so as to see the insect that is within a few inches of it, and the bird of prey which is several miles distant. And they may be seen in the air-vessels which are placed over the whole body, and which, by the constant supply of air which they furnish to the lungs, prevent respiration from being stopped or interrupted even in the swiftest flight.

The flight of birds is one of their most interesting peculiarities. The muscles by which the wings are moved are exceedingly large, and in some instances constitute not less than 1-6th of their whole weight. When a bird

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* This accounts for poultry, when wet, having a ruffled and uncomfortable appearance.

is on the ground, and intends to fly, he takes a leap, stretches his wings, and strikes them downward with great force. By this stroke the body is thrown into an oblique position. The stroke being completed, he moves up his wings; these being contracted, and having their edges turned upward, meet with little resistance from the air. When they are sufficiently elevated, he makes a second stroke downwards, and the reaction of the air again moves him forward. These successive strokes act as so many leaps taken in the air. When he wants to turn to the right or left, he strikes strongly with the opposite wing, and this impels him to the proper side. The tail acts like the rudder of a ship, except that it moves him upward or downward, instead of sidewise. If he wants to rise, he raises it; and if to fall he depresses it. In a horizontal position it keeps him steady. By spreading his wings he can continue to move horizontally for some time without striking them, because he has acquired a sufficient velocity, and his wings being parallel to the horizon, meet with but little resistance. When he begins to fall he can easily steer himself upward by his tail till the motion he had acquired is nearly spent; he must then renew it by two or three new strokes. On alighting he expands his wings and tail full against the air, that they may meet with all the resistance possible.*

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* Birds are divided into *land-birds* and *water-birds*. Land-birds are subdivided into, 1. *Rapacious birds*, which have their bill hooked, and an angular projection on each side of the upper mandible; they consist of vultures, eagles or hawks, and owls. 2. *Pies*, which have their bill sharp at the edge, compressed at the sides, and convex on the upper surface. To this order belong crows, humming-birds, parrots, woodpeckers, &c. 3. *Passerine birds*, which have a sharp-pointed bill; to which order belong finches, thrushes, larks, swallows, pigeons, &c. And, 4. *Gallinaceous birds*, which have the upper mandible considerably arched; pheasants, turkeys, peacocks, grouse, &c., belong to this order. Water-birds are subdivided into, 1. *Waders*, which have a roundish bill and fleshy tongue, and long legs; as herons, plovers, snipes, &c., which live chiefly among marshes and fens, and feed on worms; and, 2. *Swimmers*, which have the bill broad at the top, and covered with a membranous skin. The tribes

FIRST LINES OF OPTICS.—PROPERTIES OF LIGHT, REFLECTION, REFRACTION, COLOUR, THE RAINBOW.

The nature of light has not yet been ascertained, though it is frequently believed to consist of material particles thrown off from luminous bodies in all directions. But its general properties have long been fully determined.—1. *It proceeds from bodies in straight lines.* This may be shown by causing light to pass through small holes into a dark room filled with smoke or dust. It is proved also by the fact, that bodies cannot be seen through bent tubes; and it may be inferred from the form of the shadows of bodies. It is supposed that transparency is owing to the rectilineal arrangement of the pores of bodies, which enables them to act like straight tubes for the free passage of light, and that opacity is caused by an opposite arrangement, in consequence of which rays are intercepted, as if by bent tubes.—2. *The intensity of light is diminished in proportion to the square of the distance from its source.* At two feet from a candle, a person has only the fourth part of the light he would have at one foot, at three feet the ninth part, at four feet the sixteenth part, and so on.—3. *All bodies, not visible of themselves, are rendered visible by light, which originally comes from a luminous body, and which is reflected by them.* A group of persons round a fire in a field at night may be seen a great way off, though they themselves cannot see any object until it be brought near them. A person looking into a cavern sees but a very little way, as the light is not reflected from it; but if he walk forward, and turn about towards the mouth of it, he will see the objects near the mouth very distinctly, as the light from them comes to him. In like manner, the moon and planets are rendered visible by the solar light which they reflect; and accordingly when the moon comes between us and the sun, the former is invisible.—4. *Bodies reflect light of the*

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best known are the ducks, peterels, pelicans, and gulls, which live chiefly in the water, and feed on fish, worms, and aquatic plants.

same colour as themselves, although the light of the sun which renders them visible is white. This may be proved by the following beautiful experiment:—Place a white card in one end of a box shut up on all sides, place a rose-bush at the opposite end, and make a pin-hole at the same end with the rose-bush, to admit the light from the bush to the card: if you look through another hole at the card, you shall see upon the card, and opposite each rose, a patch of red light, and opposite each green leaf a patch of green light. These patches of colour constitute a picture of the rose-bush turned upside down, not very distinct indeed, but easily recognisable. If you enlarge the hole and admit more light, the picture becomes more indistinct, and the colours more faint, and when the hole reaches a certain size, the red light and the green light will fall upon the same parts of the card, and it will appear of its original whiteness.—5. *Light moves with prodigious velocity.* If two observers are placed at the distance of 80 miles, and if one of them strikes a light at a known instant of time, the light will travel to the other in such a small portion of time, that it cannot be measured by the nicest time-keepers. Astronomers have proved, by observing the eclipses of Jupiter's satellites, when that planet is nearest and farthest from the earth, that light travels from the sun to the earth in seven minutes. Hence it will move from the one pole of the globe to the other in the 24th part of a second, or at the rate of 195,000 miles in a second,—a velocity which surpasses all comprehension. This prodigious velocity proves that, if light consist of particles, these particles must be inconceivably minute; for, notwithstanding such velocity, they enter the eye, the most delicate and sensible organ of the body, without causing uneasiness. "If a particle," says Dr Thomson the distinguished chemist, "weighed a thousandth part of a grain, its force would be equal to that of a musket-ball; were it the millionth part of a grain, it would destroy everything against which it struck; if it weighed a millionth part of that, it would still have a very sensible force; but how much less must

it be, when it makes no impression upon an organ so very delicate as the eye!"

When light falls on a looking-glass or a piece of polished metal, it is thrown off or reflected. This is well known to every one; and it is true more or less of all bodies whatsoever, but especially of bodies having polished surfaces. The law which rays of light uniformly observe in their reflection is, that the angle of reflection is always exactly equal to the angle of incidence,—a law which may be seen exemplified in many common instances. If I stand before a mirror, I see my image reflected back to me. If I stand a little to the side, I cannot see myself; but a person who stands just as far on the other side of it can see my image in the glass, and I see his. If I place a candle a little to one side, I must go as far on the other to see its image in the glass.

Light naturally proceeds in straight lines; but as it is subject, in common with other bodies, to attraction, it may be drawn or bent out of its course; this is what is called the *refraction* of light. This never happens except it passes out of one medium into others of different density; as out of air into water or glass, or out of water or glass into air. The laws of refraction cannot be well explained without the aid of mathematics; but some general idea of its nature may be formed by attending to familiar appearances. The end of a stick, when put in water, appears bent in consequence of refraction which the light suffers in passing from air, a rare medium, into water, a dense medium. If a shilling be put in a basin, and the eye placed so as just to see the edge of the shilling, then if water be poured into the basin, the shilling will be seen most distinctly; for, when no water was in the basin, the rays of light from the shilling, proceeding in straight lines, were prevented from reaching the eye by the side of the basin, but when water was poured in they suffered a refraction in emerging from it a dense medium, into air a rare medium, and conse-

quently proceeded to the eye. It is to the refraction which the sun's rays suffer in passing through the atmosphere, which is a medium increasing in density as it approaches the earth, that we are indebted for the evening and morning twilight. The degree of refraction is greatly affected by the state of the atmosphere. Sailors very well know, that a ship may be seen much farther off at one time than at another: and so also may the land. Sumburgh-head, the most southern promontory of Shetland, cannot be seen from North Ronaldshay, in the Orkneys, in the clearest weather; but it may be seen sometimes, and then heavy rains never fail to set in: it is the moisture which increases the refraction. It is in consequence also of the property of refraction that lenses and other optical instruments are so available to the purposes of man. A *lens* is usually made of polished glass, and has different names according to its shape; as prism, double-convex lens, plano-convex lens, meniscus, &c.—The two kinds most commonly in use are the convex and the concave. The glasses of spectacles for old people, or burning-glasses, are convex lenses; an eyeglass for short-sighted people is a concave lens. A convex lens collects the rays of light into a point called a focus, which, in a single convex lens, is the centre of the sphere of which the lens is a part. A piece of paper or a pipe of tobacco may be lighted by such a lens; and it is to be observed, that a body of a black colour will be kindled most readily: a white-coloured substance is kindled with more difficulty, as it reflects a great part of the light thrown upon it. The largest burning-glass ever known was that sent to the Emperor of China in the embassy of Lord Macartney. A voyager to the North Pole is said to have made a large burning-glass of ice, which set fire to wood, to the great astonishment of the sailors; and Plutarch informs us, that when the vestal virgins allowed the sacred fire to go out, they were obliged to kindle it by means of the rays of the sun collected by a burning-glass.—(*See Illust. Fig.* 27.)

LIGHT was long thought to be a simple substance, but

it has been decomposed by Sir Isaac Newton. He made the solar rays to pass through a triangular prism, and found that, from their different degrees of refraction, they were separated into the seven kinds of rays which are seen in the rainbow,—red, orange, yellow, green, blue, indigo, and violet.* The violet ray suffers the greatest refraction, and the red the least. The colour of any object, according to Sir Isaac Newton, is caused by its being so constructed as to absorb certain rays, and to reflect others. Objects accordingly have no colour in the dark. White is occasioned by the body being so constructed as to reflect all the seven primary colours. Black is occasioned by their absorption, and is, strictly speaking, the absence of all colour. Hence, since light and heat are inseparably connected, white is the coolest dress in summer, and black the warmest. Hence, too, a person dressed in white is seen at some distance in the street at night, whilst a person in a dress of a dark colour is not. Men who go to shoot rabbits at night, rub the barrel of their guns with chalk that they may be able to take aim. In Italy, the houses are covered with a white plaster, to keep them cool; and a whitened wall is supposed to ripen the fruit of trees fastened against it better than a mere brick wall. The most striking example of the decomposition of light is that presented by the rainbow. This beautiful phenomenon is never seen but in the time of rain or near it, and when the sun shines. When a ray from the sun falls upon a drop of rain in a cloud, if it enter the upper part of the drop in a proper situation, it will, by refraction, be thrown upon the inner surface of the back part of the drop; from thence it will be reflected to the lower part of the drop, at which place, undergoing a second refraction, it will be bent towards the earth; and

* The following simple experiment shows, that the seven primitive colours, when arranged in certain proportions, produce white:—Divide a circular piece of wood, as the rim of a top, into 360 equal parts; paint 45 of these parts *red*, 37 *orange*, 48 *yellow*, 50 *green*, 60 *blue*, 40 *indigo*, and 80 *violet;* then make the top spin rapidly. If the colours are pure, it will appear perfectly white.

thus rays of the sun, after one reflection and two refractions, may come to the eye of a spectator, whose back is towards the sun, and his face towards the drop. When rays which are effectual emerge from the drop after one reflection and two refractions, those which are most refrangible will, at their emersion, make angles with the incident rays different from those which are least refrangible; by which means the rays that produce the sensations of different colours will be separated from one another. Hence it may be easily perceived that some of the fallen globules may be in that position which will cause the rays that produce a red colour to fall upon the eye,—others next to them below will send forth orange-making rays,—the drops next to them will cast the yellow-making rays,—and those successively in order below them will refract the blue, indigo, and violet-making rays to the eye;—and thus, in a certain space in the cloud, all the colours will appear; and since, under the same angles, the same phenomena will be produced, therefore an arch of this various-coloured light must necessarily be produced in the clouds. —(*See Illustrations*, *Fig.* 28.)

THE CAST-AWAY SHIP.*

A VESSEL sail'd from Albion's shore,
  To utmost India bound;
Its crest a hero's pendant bore,
  With broad sea-laurels crown'd;
In many a fierce and noble fight,
Though foil'd on that Egyptian night,
  When Gallia's host was drown'd,
And Nelson o'er his country's foes,
Like the destroying angel rose.

A gay and gallant company,
  With shouts that rend the air,

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* The Blenheim, commanded by Sir T. Troubridge, was separated from the vessels under its convoy in the Indian Ocean, and never was heard of more. The same officer's ship, at the battle of the Nile, had run aground as it was bearing down on the enemy.

For warrior-wreaths upon the sea,
  Their joyful brows prepare;
But many a maiden's sigh was sent,
And many a mother's blessing went,
  And many a father's prayer,
With that exulting ship to sea,
With that undaunted company.

The deep, that, like a cradled child,
  In breathing slumber lay,
More warmly blush'd, more sweetly smiled,
  As rose the kindling day;
Through ocean's mirror, dark and clear,
Reflected clouds and skies appear
  In morning's rich array:
The land is lost, the waters glow,
'Tis heaven above, around, below.

No fear the brave adventurers knew;
  Peril and death they spurn'd:
Like full-fledged eagles forth they flew;
  Jove's birds, that proudly burn'd
In battle-hurricanes to wield
His lightnings on the billowy field;
  And many a look they turn'd
O'er the blue waste of waves to spy
A Gallic ensign in the sky.

But not to crush the vaunting foe,
  In combat on the main,
Nor perish by a glorious blow,
  In mortal triumph slain,
Was their unutterable fate;
—That story would the muse relate,
  The song might rise in vain;
In ocean's deepest, darkest bed,
The secret slumbers with the dead.

On India's long-expecting strand
  Their sails were never furl'd;
Never on known or friendly land
  By storms their keel was hurl'd;
Their native soil no more they trod;
They rest beneath no friendly sod:
  Throughout the living world,

This sole memorial of their lot
Remains—they *were* and they *are not!*

The Spirit of the Cape pursued
  Their long and toilsome way;
At length, in ocean solitude,
  He sprung upon his prey;
"Havoc!" the shipwreck demon cried,
Loosed all his tempests on the tide,
  Gave all his lightnings play;
The abyss recoil'd before the blast,
Firm stood the seamen till the last.

Like shooting stars athwart the gloom
  The merchant-sails were sped;
Yet oft, before its midnight doom,
  They mark'd the high mast-head
Of that devoted vessel, tost
By winds and floods, now seen, now lost;
  While every gun-fire spread
A dimmer flash, a fainter roar:
At length they saw, they heard no more.

There are to whom that ship was dear,
  For love and kindred's sake:
When these the voice of Rumour hear,
  Their inmost heart shall quake,
Shall doubt, and fear, and wish, and grieve,
Believe and long to unbelieve,
  But never cease to ache;
Still doom'd, in sad suspense, to bear
The Hope that keeps alive Despair.

MONTGOMERY.

THE DEATH OF CHRIST.—THE MALIGNITY OF SIN.

THE importance of an event cannot be accurately estimated by the degree of interest which it immediately excites. Many events which, on their occurrence, seemed big with the fate of generations, have passed by, and are forgotten; while, on the other hand, the most exten-

sive and lasting revolutions have often flowed from incidents apparently casual and trifling. The black clouds, which threaten a deluge, are often entirely dissipated, without leaving a trace behind of the impending tempest; while a cloud, at first scarcely bigger than a man's hand, at last overspreads the firmament with darkness, and pours out an unexpected and desolating tempest.

There is not to be found, in the history of the human race, an instance in which apparent insignificance is more strongly contrasted by real importance, than that which is so simply recorded in the words, "Jesus yielded up the ghost." In this event, if we look merely at its external circumstances, there is nothing to secure remembrance. Man's giving up the ghost is an event of daily, of hourly recurrence. There was indeed something peculiar in this case; for Jesus died upon a cross. But is there anything uncommonly interesting in the fact, that a poor and unfriended Jew, accused by his countrymen of aspiring to temporal rule, or to divine honours, should fall a victim to their hatred, and expiate his supposed crimes by crucifixion? The severity of his punishment, when contrasted with the deficiency of the evidence on which he was condemned, might indeed be supposed to excite some degree of sympathy in the spectators; but certainly the probability was, that every vestige of his existence would, in the course of a few years at the latest, perish from the earth.

Yet this event, apparently so trivial, formed the grand and concluding action in a scene the most interesting and important which ever was, which ever will be, which ever can be exhibited on earth. Amid apparent meanness, there was real grandeur; amid seeming insignificance, there was infinite importance. That Jesus who on the cross yielded up his spirit, was the only begotten Son of God in human nature. That life which he there laid down was the ransom of men innumerable. Heaven, earth, and hell, felt the Saviour's dying groan. From that event, consequences infinitely numerous, immensely important, and unspeakably interesting, have flowed. Rev-

olutions, deeply affecting the present and the immortal interests of mankind, have been its result in this world; while, among its consequences in the invisible state, faith beholds a guilty elect world restored to the favour of its Creator, the divine government vindicated, and the gates of paradise set open. While thrones the most ancient and stable have been crumbled into dust, and their proud possessors forgotten among men,—while the renown of the warrior and the statesman, the philosopher and the poet, has passed away, the death of Jesus on a cross is remembered with the profoundest veneration: And now, at the distance of nearly two thousand years since this decease was accomplished in Palestine, we, the inhabitants of a remote district in a distant island of the sea, have met together to celebrate a religious rite instituted for its commemoration.* BROWN.

THE malignity of moral evil is evident from its opposition to the character and will of Him who is essential holiness and truth: it involves, in its essence, the violation of obligations inconceivably strong; rebellion against the highest authority, and ingratitude for the greatest goodness: contempt for infinite condescension, and defiance to infinite power. Its malignity is written, too, in legible characters on the ills of life—sickness, disease, and pain—pestilence, famine, and war—disappointment, sorrow, and remorse—in the agonies of dissolution, and the torments of hell. But he who would see sin in all the hatefulness of its nature, and the horror of its deserts, must turn the eye of the mind to an incarnate, suffering, dying Saviour—to Bethlehem, to Gethsemane, and to Calvary. Behold Him, who is the brightness of his Father's glory, and the express image of his person; who is God over all blessed for ever, clothed in human nature, and leading the life of a man of sorrows! Behold the Lord of angels insulted by men, and tempted by the

* This extract is taken from a sermon preached at the administration of the Lord's Supper.

devil! Behold the Son of God hanging on a cross, deserted of his Father, and suffering the dreadful effects of his indignation, while nature shudders at the sight, and the sun hides his face from beholding a sight so horrible! And then say if it is a light thing to violate the obligations of the divine law, to contemn the authority of the God of heaven. *Id.*

Oh! never, never canst thou know
  What then for thee the Saviour bore,
The pangs of that mysterious woe
  That wrung his frame at every pore,
The weight that press'd upon his brow,
  The fever of his bosom's core!
Yes, man for man perchance may brave
The horrors of the yawning grave,
And friend for friend, or child for sire,
Undaunted and unmoved expire,—
From love—or piety—or pride;—
But who can die as Jesus died?

A sweet but solitary beam,
  An emanation from above,
Glimmers o'er life's uncertain dream,
  We hail that beam and call it love!
But fainter than the pale star's ray
Before the noontide blaze of day,
And lighter than the viewless sand
Beneath the wave that sweeps the strand,
Is all of love that man can know,—
All that in angel-breasts can glow,—
Compared, O Lord of Hosts! with thine,
Eternal—fathomless—divine! Dale.

MOTIONS OF THE EARTH, MOON, AND PLANETS.

Tutor. Charles.

T. Now, my young friend, that you have finished your perusal of the little treatise on astronomy that I gave you, I mean to put your understanding and memory a

little to the test, by asking a few questions respecting its contents. You recollect the names and natures of the different heavenly bodies?

C. They are divided into *fixed stars*, *planets*, and *comets*. The fixed stars are supposed to be suns, the planets inhabited worlds like our own, and the comets—their nature is not so well understood; they are generally remarkable, however, for their *luminous tails*, the velocity of their motions, and the eccentricity of their orbits.

T. The planets, you know, have each two motions, a *diurnal*, round their axis, and an *annual*, round the sun—can you mention the effects which these motions respectively produce?

C. The former causes the vicissitude of day and night, the latter the succession of the seasons.

T. Were the axis of the earth perpendicular to its orbit, would these changes occur exactly as at present?

C. In that case there could be no variety in the length of the day and night at any one point of the earth's surface, and very little, if any, change of season.

T. In its motion round the sun the axis of the earth is always inclined at the same angle to the plane of its orbit—how does this account for the difference of the length of the days and for the seasons?

C. At the spring equinox both poles are equidistant from the sun, and the solar rays fall directly on the equator; the inhabitants of both temperate zones are in the same state as to temperature, so are the inhabitants of both frigid zones; and the length of the day and night is necessarily equal all over the world. But when the earth reaches that part of her orbit, when it is midsummer to us and to all the inhabitants of the northern hemisphere, the north pole is turned towards the sun, the south pole turned from him, and the solar rays fall directly upon the northern tropic. There is consequently continual day in the north frigid, long days and short nights in the north temperate, and total darkness in the south frigid zone. At the autumnal equinox, the earth

is in nearly the same situation as at the vernal; and, at our mid-winter, the south pole is turned to the sun, and the north pole turned from it.*—(*See Illustrations, Fig.* 29.)

T. Now give me, if you please, an equally distinct account of the phases of the moon.

C. When the new moon is first seen from the earth, she appears a slender crescent on the left of the sun, with the convex side turned towards him. As she recedes from the sun, the crescent gradually increases in breadth. When she has performed an eighth part of her revolution round the earth, she is said to be in her first octant, and appears a quarter-moon. In less than four days after this she is in her quadrature, and has the form of a half-moon. After the same interval of time she reaches her second octant, and becomes gibbous, or exhibits an intermediate figure between half and full moon. In a few days she assumes a form completely round, and is in opposition to the sun, and is seen upon the meridian at midnight. After this she begins to decrease in size, and presents, in succession, but in an inverted order, precisely the same forms which she exhibited when on the increase, with this difference, that the side of the disc which was first illuminated now first disappears. In about eleven days after full moon, she is seen in the morning, on the right of the sun, in the shape of a thin crescent, with her convex side towards him as at first; and after this she gradually disappears. About six days afterwards she reappears on the other side of the sun, and exhibits again the same changes.—(*See Illustrations, Fig.* 30.)

T. Of course you have taken it for granted that these phases are owing to the moon's being an opaque body, and deriving her light from the sun. Indeed the same appearances are exhibited by carrying an ivory ball, or small globe, round a lighted candle. With such an accurate conception of the relative position of the sun, earth, and moon, you found, I presume, no difficulty in comprehending the doctrine of eclipses?

* These changes are very well illustrated by Jones's Portable Orrery.

C. An eclipse of the sun is occasioned by the body of the moon being interposed between the sun and the spectator, and consequently can happen only when the moon is in conjunction, or at new moon. An eclipse of the moon is produced by the moon passing through the earth's shadow, and can therefore happen only when the moon is full, or in opposition to the sun.

T. But why then do not eclipses happen at every new and full moon?

C. This would be the case, if the moon's orbit coincided, or was in the same plane with the earth's orbit; but as the moon's orbit is inclined to that of the earth at an angle of above 5°, it follows that the moon, earth, and sun, can only be in the same plane at the time of passing the nodes, that is, when the two orbits cross each other. Now, the moon can be in the nodes only twice in the course of a revolution; consequently she may perform a number of revolutions before she finds the sun exactly on that point of the ecliptic when she cuts it, or on the point immediately opposite; therefore a *central* eclipse, either of the sun or moon, must occur very seldom. Partial eclipses must happen more frequently.

T. Are the sun and moon, as seen from the earth, always of the same apparent magnitude?

C. No. Both the sun and moon vary both in apparent magnitude and in apparent velocity; and when their apparent magnitude is greatest, their apparent velocity is also greatest. These appearances, too, are easily explained: the earth and moon (and the same thing is true of all the planets) do not move in circular but in elliptical orbits. The sun is in one of the foci of the earth's orbit, and the earth is in one of the foci of the moon's orbit; consequently the sun and moon are nearer, and therefore appear larger, at one time than at another.

T. The planets Mercury and Venus are called *inferior*, and the planets Mars, Jupiter, Saturn, and Herschel, *superior*, because the orbits of the former are within that of the earth; and those of the latter without it;—do you

remember any points of distinction between their apparent motions?

C. The former are always found in the immediate neighbourhood of the sun, the latter recede from him to all distances; the former are never seen in opposition, or on the meridian at midnight, the latter frequently; the former are observed occasionally to cross the sun's disc when in conjunction, the latter never. In one point, however, there is a remarkable agreement between the two; the apparent motion of all the planets is sometimes direct, sometimes retrograde, and sometimes stationary.

T. Are all these phenomena satisfactorily accounted for on the supposition that the planetary bodies all move in orbits more or less circular round the sun?

C. Yes; and they can be explained on no other supposition. The fact, that the superior planets are seen in opposition, proves that the earth moves between them and the sun, and the fact, that the inferior planets are occasionally seen crossing the sun's disc, as plainly proves that they move between the earth and the sun. The change of apparent motion, too, is an equally convincing proof of their actual revolution round the sun; for the same appearances may be observed in an orrery, where a number of balls are made to revolve round a central body.

T. I doubt not you were very much interested in tracing the apparent motions of Venus, the morning and evening star.

C. They seemed at first somewhat complex; but, now that I understand the *real* motions, I have no difficulty with them; shall I describe them?—About two months after her inferior conjunction, Venus begins to appear in the gleam of the evening twilight about 19° on the left of the sun. She continues to recede from him night after night, till her angular distance is about 47°, after which she begins to approach him again, and continues to move towards him till her angular distance is about 28°. She now appears to become stationary for

a little, and afterwards commences a retrograde motion. In a few days she is hid in his rays in the evening, and continues invisible about six weeks, when she is again seen in the morning on the other side of the sun, disengaging herself from his rays and retiring from him. She is now coming from her inferior conjunction, and is called the *morning star*. Appearances nearly the same occur until she comes again to her superior conjunction, after which she is again the *evening star*. The time she takes to perform an entire revolution is about eighteen months.

T. I shall not detain you longer at present. At some future opportunity I may examine you on your knowledge of the theory of gravitation, the causes of the celestial motions, and the phenomena of the tides; but I am already satisfied that you have perused the little treatise on astronomy with great attention and perfect intelligence.

DETACHED SELECTIONS FROM COWPER.

O HOW unlike the complex works of man,
Heaven's easy, artless, unencumber'd plan;
No meretricious graces to beguile,
No clustering ornaments to clog the pile;
From ostentation as from weakness free,
It stands like the cerulean arch we see,
Majestic in its own simplicity.
Inscribed above the portal, from afar
Conspicuous as the brightness of a star,
Legible only by the light they give,
Stand the soul-quickening words—BELIEVE AND LIVE.

YON cottager, who weaves at her own door,
Pillow and bobbins all her little store;
Content though mean, and cheerful if not gay,
Shuffling her threads about the livelong day,
Just earns a scanty pittance, and at night
Lies down secure, her heart and pocket light:
She, for her humble sphere by nature fit,
Has little understanding, and no wit,

Receives no praise; but, though her lot be such,
(Toilsome and indigent) she renders much;
Just knows, and knows no more, her Bible true,—
A truth the brilliant Frenchman never knew;
And in that charter reads with sparkling eyes
Her title to a treasure in the skies.

O happy peasant! Oh unhappy bard!
His the mere tinsel, hers the rich reward;
He praised perhaps for ages yet to come,
She never heard of half a mile from home:
He lost in errors his vain heart prefers,
She safe in the simplicity of hers.

There lives and works
A soul in all things, and that soul is God.
The beauties of the wilderness are His,
That make so gay the solitary place,
Where no eye sees them. And the fairer forms,
That cultivation glories in, are His.
He sets the bright procession on its way,
And marshals all the order of the year;
He marks the bounds, which winter may not pass,
And blunts his pointed fury; in its case,
Russet and rude, folds up the tender germ,
Uninjured, with inimitable art;
And, ere one flowery season fades and dies,
Designs the blooming wonders of the next.
The Lord of all, himself through all diffused,
Sustains, and is the life of all that lives.
Nature is but a name for an effect,
Whose cause is God. One spirit—His,
Who wore the platted thorns with bleeding brows,
Rules universal nature. Not a flower
But shows some touch, in freckle, streak, or stain,
Of his unrivall'd pencil. He inspires
Their balmy odours, and imparts their hues,
And bathes their eyes with nectar, and includes,
In grains as countless as the seaside sands,
The forms with which he sprinkles all the earth.
Happy who walks with him! whom what he finds
Of flavour or of scent in fruit or flower,

Or what he views of beautiful or grand
In Nature, from the broad majestic oak
To the green blade that twinkles in the sun,
Prompts with remembrance of a present God.

—And seems it nothing in a father's eye,
That unimproved the hours of boyhood fly?
And is he well content his son should find
No nourishment to feed his growing mind
But conjugated verbs, and nouns declined?
Perhaps a father, blest with any brains,
Would deem it no abuse, or waste of pains,
To improve this diet, at no great expense,
With savoury truth and wholesome common sense;
To lead his son, for prospects of delight,
To some not steep, though philosophic height,
Thence to exhibit to his wondering eyes
Yon circling worlds, their distance, and their size;
The moons of Jove, and Saturn's belted ball,
And the harmonious order of them all;
To show him in an insect, or a flower,
Such microscopic proof of skill and power,
As, hid from ages past, God now displays,
To combat atheists with in modern days;
To spread the earth before him, and commend,
With designation of the finger's end,
Its various parts to his attentive note,
Thus bringing home to him the most remote;
To teach his heart to glow with generous flame,
Caught from the deeds of men of ancient fame:
And, more than all, with commendation due,
To set some living worthy in his view,
Whose fair example may at once inspire
A wish to copy what he must admire.
Such knowledge gain'd betimes, and which appears,
Though solid, not too weighty for his years,
Sweet in itself, and not forbidden sport,
When health demands it, of athletic sort,
Would make him—what some lovely boys have been,
And more than one perhaps that I have seen—

An evidence and reprehension both
Of the mere schoolboy's lean and tardy growth.

Patron of all those luckless brains, that, to the wrong side leaning,
Indite much metre with much pains, and little or no meaning:
Ah why, since oceans, rivers, streams, that water all the nations,
Pay tribute to thy glorious beams, in constant exhalations,
Why, stooping from the noon of day, too covetous of drink
Apollo, hast thou stolen away a poet's drop of ink?
Upborne into the viewless air it floats a vapour now,
Impell'd through regions dense and rare, by all the winds that blow,
Ordain'd perhaps ere summer flies, combined with millions more,
To form an Iris in the skies, though black and foul before.
Illustrious drop! and happy then beyond the happiest lot,
Of all that ever pass'd my pen, so soon to be forgot!
Phœbus, if such be thy design, to place it in thy bow,
Give wit, that what is left may shine with equal grace below.

WONDERS OF VISION.

Let me suppose myself stationed on Arthur's Seat, in the vicinity of Edinburgh. Turning my face to the north-west, the city, with its castle, spires, and stately edifices, presents itself to my view. Beyond it, on the north and west, a beautiful country, adorned with villas, plantations, and fertile fields, stretches as far as the eye can reach, till the view is bounded by the Castle of Stirling, at a distance of more than thirty miles. On the right hand I behold the port of Leith, the shipping in the roads, the coast of Fife, the isles of Inchkeith and May, and the frith of Forth gradually losing itself in the German Ocean.

Now let me consider first *the immense multitude of rays of reflected light* which flow, in all directions, from the

objects which compose this scene. In order to form a rude idea of this infinity of radiations, I fix my attention on a single object. I direct my eye to Nelson's Monument, on the Calton Hill. From the parapet at the top a thousand different points send forth a thousand different cones of rays, which, entering my eye, render the different parts of it distinctly visible. How many thousands of millions, then, of different radiations, must be issuing forth every moment from the whole mass of the monument! And if one object pours forth such a flood of rays, how immense must be the number of radiations which are issuing from all the objects which compose this extensive landscape! But this is not all; these millions of rays, which flow from the minutest points of the surrounding scene, before they can produce the sensation of vision, and form a picture of the landscape on the retina, must all pass through the small aperture of the eye without the least confusion, and paint the images of their respective objects in exactly the same order in which these objects are arranged.—(*See Illust. Fig.* 31.)

Let me now attend to the *small space* within which the images are depicted at the bottom of my eye. All the objects I am now surveying, comprehending an extent of a thousand square miles, are accurately delineated in the bottom of my eye, on a space *less than half an inch* in diameter. How delicate, then, must be the strokes of that Divine pencil which has formed such a picture! I turn my eyes to the castle of Edinburgh, which appears one of the most conspicuous objects in my field of view. Supposing that portion of it which strikes my eye to be 500 feet long, and 90 in height, I find, by calculation, that it occupies only the six-hundred-thousandth part of the whole landscape, and consequently fills in my eye no more than the twelve-hundred-thousandth part of an inch. I next direct my eye towards the frith of Forth, and perceive a steam-boat sailing between Queensferry and Newhaven. I distinctly trace its motion for the space of 40 minutes, at the end of which it reaches the chain-pier at Newhaven, having passed over a space of five miles in length, which is but the eighth part of the

lineal extent of the landscape in that direction; and, consequently, occupies, in the picture formed on my retina, a lineal space of only one-sixteenth of an inch in extent. And, if the boat be reckoned about 88 feet in length, its image is only the three-hundredth part of this extent; and, of course, fills a space in the eye of only the four-thousand-eight-hundredth part of a *lineal* inch. Yet my perception of the motion of the vessel could be produced only by a corresponding motion of its image in my eye; that is, by the *gradual* motion of a point $\frac{1}{4800}$th of an inch in diameter, over a space one-sixteenth of an inch in length. How inconceivably fine and accurate, then, must be the impression which the rays of light produce on the retina of the eye! How delicate must be the strokes of that Divine pencil which forms such a picture! DICK.

THE ART OF PRINTING.

VARIOUS cities have claimed the honour of this invention; but it is now generally admitted to be due to Haerlem, a town in Holland. It is attributed to Laurence Koster, an alderman of that city, in 1440. Amusing himself one day in the neighbouring wood, with cutting the bark of trees into the letters that formed the initials of his name, he is said to have laid them on paper, and afterwards observed, that from the dew their form was impressed on the paper. This accident induced him to make further experiment; he next cut his letters in wood, and, dipping them in a glutinous liquid, impressed them on paper, which he found an improvement; and soon after, substituting leaden and pewter letters, erected a press in his house; thus laying the foundation of this noble art, which has thence gradually risen to its present excellence. The art, it is said, was stolen from him by his servant, John Faustus, who conveyed it to Mentz, and, from the novelty of the discovery, soon acquired the title of doctor and conjuror.

By the gradual improvement of this art, and its application to the diffusion of knowledge, a new era has

been formed in the annals of the human race. In the flourishing ages of Greek and Roman literature, none but persons of rank and property could acquire any knowledge of letters; and this must have ever continued to be the case, had not this invention, by reducing books to less than a hundredth part of their former price, facilitated the diffusion of knowledge. We have it from good authority, that about A. D. 1215, the Countess of Anjou gave 200 sheep, five quarters of wheat, and the same quantity of rye, for a volume of sermons; and it is also upon record, that the value of manuscript Bibles commonly was from 400 to 500 crowns,—a sum which, according to the relative value of money then and now, could not be less than as many pounds sterling at the present day. How trifling would be the literary attainments of the people of modern Europe, if such a state of things still existed! The typographic art has contributed infinitely more to the improvement of the human mind, and the civilisation of the species, than all the speculations and discoveries of philosophy. To it we owe the Reformation from Popery—the rank we occupy as a nation—the sublime discoveries of science—the blessed diffusion of religion. And if ever the benefactors of mankind deserved to have statues erected to their honour, the inventors of the art of printing are certainly the men; for of all events which have ever happened among mankind, this invention constitutes, next to the establishment of Christianity, the most interesting and important.

THE MARINER'S COMPASS.—(*See Illustrations, Fig.* 32.)

THE invention of the compass is usually ascribed to Flavio Gioia, of Amalfi, in Campania, about the year 1302; and the Italians are strenuous in supporting this claim. Others affirm, that Marco Polo, a Venetian, having made a journey to China, brought back the invention with him in 1260. The French also lay claim to the honour of this invention, from the circumstance that all nations distinguish the *north* point of the card by

a *fleur de lis;* and, with equal reason, the English have laid claim to the same honour, from the name *compass*, by which most nations have agreed to distinguish it. But, whoever were the inventors, or at whatever period this instrument was first constructed, it does not appear that it was used in navigation in Europe before the year 1420, or only a few years before the invention of printing.

In consequence of the discovery of this instrument, the coasts of almost every land on the surface of the globe have been explored, and a regular intercourse between the most distant nations opened. The fate of the great human families indeed has been in a great measure decided by navigation. Is not the perpetual infancy of the Chinese owing chiefly to their ignorance of this art? On the contrary, if the Japanese and the Malays exhibit a character manly and enterprising, in comparison of that of other Asiatics, it was formed at the epoch when their squadrons traversed the great eastern ocean, which is at present filled with their colonies. What has kept the people of Africa stationary in ignorance but their inland situation, their destitution of gulfs and arms of the sea, their inaccessibility to navigation? What has given their ascendency to the European nations but their knowledge of navigation, and the aptitude of their countries for carrying it on? Since the compass and Columbus appeared, has not a new world seen our vessels land on its shores—has not a new Europe arisen—and has not the Atlantic ocean become what the Mediterranean was before, the great highway and thoroughfare of the civilized world?

But the march of civilisation is far from being terminated; the wonders we have witnessed may still be surpassed. The Europeans have not confined themselves to the shores of that Atlantic ocean which, immense as it appeared to the Phœnician and the Greek navigators, is only an arm of the sea, compared to that great ocean which, under the names of the Indian, the Pacific, and the Eastern, extends from pole to pole. The American navigators have already crossed the whole of this aquatic hemisphere—already British colonists have begun

to settle in the innumerable islands which form, to the south-east of Asia, a fifth part of the world; and Australasia, the most delightful country of the globe, will probably, ere many ages pass away, have reached the highest pinnacle of civilisation. Let another Cadmus carry thither that torch of religion and science which enlightens Europe! Let colonists, fraught with our learning, found a new Greece in Otaheite or the Pelew Islands, then those rising grounds, which now produce only aromatic herbs, will be covered with towns and palaces: bays, now shaded by a forest of palms, will display a forest of masts; gold and marble will be extracted from the bowels of mountains as yet untouched by the miner; coral and pearls will be dragged from the bottom of the sea to adorn the new capitals; and one day, perhaps, Europe, Asia, Africa, and America, will find equals and rivals in countries, whose existence at this moment scarcely occupies their attention.

THE ENGLISH IN PORTUGAL.

A VARIOUS host they came—whose ranks display
Each mode in which the warrior meets the fight;
The deep battalion locks its firm array,
And meditates his aim the marksman light;
Far glance the lines of sabres flashing bright,
Where mounted squadrons shake the echoing mead—
Lacks not artillery breathing flame and night,
Nor the fleet ordnance whirl'd by rapid steed,
That rivals lightning's flash, in ruin and in speed.

A various host—from kindred realms they came,
Brethren in arms, but rivals in renown—
For yon fair bands shall merry England claim,
And with their deeds of valour deck her crown.
Hers their bold port, and hers their martial frown,
And hers their scorn of death in freedom's cause,
Their eyes of azure, and their locks of brown,
And the blunt speech that bursts without a pause,
And freeborn thoughts, which league the soldier with the laws.

And, oh! loved warriors of the Minstrel's land!
Yonder your bonnets nod, your tartans wave!

The rugged form may mark the mountain band,
And harsher features, and a mien more grave;
But ne'er in battle-field throbb'd heart so brave
As that which beats beneath the Scottish plaid;
And when the pibroch bids the battle rave,
And level for the charge your arms are laid,
Where lives the desperate foe that for such onset staid!

Hark! from yon stately ranks what laughter rings,
Mingling wild mirth with war's stern minstrelsy,
His jest while each blithe comrade round him flings,
And moves to death with military glee:
Boast, Erin, boast them! tameless, frank, and free,
In kindness warm, and fierce in danger known,
Rough Nature's children, humorous as she;
And He, yon Chieftain—strike the proudest tone
Of thy bold harp, green Isle!—the Hero is thine own.

Sir Walter Scott.

THE DESTRUCTION OF SENNACHERIB.

The Assyrian came down like the wolf on the fold,
And his cohorts were gleaming in purple and gold;
And the sheen of their spears was like stars on the sea,
When the blue wave rolls nightly on deep Galilee.
Like the leaves of the forest when Summer is green,
That host with their banners at sunset were seen:
Like the leaves of the forest when Autumn hath blown,
That host on the morrow lay wither'd and strown.

For the Angel of Death spread his wings on the blast,
And breathed in the face of the foe as he pass'd;
And the eyes of the sleepers wax'd deadly and chill,
And their hearts but once heaved, and for ever grew still!
And there lay the steed with his nostril all wide,
But through it there roll'd not the breath of his pride:
And the foam of his gasping lay white on the turf,
And cold as the spray of the rock-beating surf.

And there lay the rider distorted and pale,
With the dew on his brow, and the rust on his mail;
And the tents were all silent, the banners alone,
The lances unlifted, the trumpet unblown.

And the widows of Ashur are loud in their wail,
And the idols are broke in the temple of Baal;
And the might of the Gentile, unsmote by the sword,
Hath melted like snow in the glance of the Lord!

BYRON.

THE ANIMAL ECONOMY CONTINUED.—FISHES, INSECTS.

Fishes.—So far as the structure and functions of fishes have been ascertained, their external and internal conformation appear admirably adapted to their element and mode of life. Their shape, it cannot escape the most careless observer, is finely fitted to cleave their native deeps with the least possible resistance. The use of their fins and tail, too, is obvious; and the belly-fins cannot appear unnecessary, when it is recollected that their centre of gravity lies near the back, and that without some kind of feet they would float with their backs downward.

But some of their parts display contrivance which cannot be understood without closer examination. The *gills*, placed on each side of the neck, are the organs by which they breathe. In this operation they fill their mouth with water, which they throw backward with so much force as to lift open the great flap, and force the water out behind. And in the passage of this water, all or at least the greater part of the air contained in it is left behind, and carried into the body to perform its part in the animal economy. The *air-bladder*, which lies in the abdomen, along the course of the backbone, is an admirable contrivance for enabling them to increase or diminish their specific gravity, and thus sink or rise in the water. If they want to sink, they compress this bladder by means of their abdominal muscles, so that the bulk of their body is diminished. If they want to rise, they relax the pressure of the muscles, the air-bladder again acquires its natural size, the body is rendered more bulky, and they ascend towards the surface. Fish which are destitute of air-bladders have little facility of raising themselves in the water. The greater number of them consequently remain at the bottom, unless the form of

their body enables them to strike the water downward with great force. This the skate, the thornback, and other species of *rays*, do with their large pectoral fins, which act upon the water in the same manner as the wings of birds do upon the air.*

Insects.—All insects (except the *apterous* tribe, which proceed nearly in a perfect state from the egg) undergo a *metamorphosis* at three different periods of their existence. The lives of these minute creatures, in their perfect state, is in general so short, that the parents have seldom an opportunity of seeing their living offspring; consequently they are neither provided with milk, like viviparous animals, nor impelled to sit upon their eggs, like birds. In place of these, the all-directing Power has endowed them with the astonishing faculty of being able to discover what substance is fitted to afford the food proper for their young, though that food is, for the most part, totally different from that which the parent itself would eat. Some of them attach their eggs to the bark, or insert them into the leaves of trees and other vegetable substances; others form nests, which they store with insects or caterpillars, that will attain the exact state in which they may afford proper food for their young ones when they shall awaken into life; others convey their eggs into the body, and even into the internal viscera, of larger animals; others drop them into the water, an element in which they could not themselves subsist. From the eggs of all insects proceed what are called

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* The fishes were divided by Linnæus into six orders:—1. *Apodal*, with bony gills, and no ventral fins, as the eels. 2. *Jugular*, with bony gills, and ventral fins before the pectoral ones, as the cod and haddock. 3. *Thoracic*, with bony gills, and ventral fins placed directly under the thorax, as the turbot, sole, perch, and mackerel. 4. *Abdominal*, with bony gills, and ventral fins placed behind the thorax, as the salmon, pike, herring, and carp. 5. *Branchiostegous*, with gills destitute of bony rays, as the pike-fish and the lump-fish. 6. *Condropterygious*, with cartilaginous gills, as the sturgeon, shark, skate, and lampron.

larvae, grubs, or caterpillars. These consist of a long body, covered with a soft, tender skin, divided into segments or rings. In this larva state some insects remain for months, others for a year, and some even for two or three years; and they are, in general, exceedingly voracious, oftentimes devouring more than their own weight in the course of a day. As soon as their parts become perfected, they fix upon some convenient place for undergoing the change into what is called *pupa*, *aurelia*, or *chrysalis*. This is generally a place where they are safe from aggression, as in their transformation they have neither strength to resist, nor swiftness to avoid, the attack of an enemy. The Power which instructed the parents to deposit their eggs in a proper receptacle, directs the offspring to secure and appropriate situations for their future defenceless state. Some of them spin webs or cones, in which they enclose themselves; others wrap themselves up in leaves of vegetables; and many conceal themselves beneath the surface of the earth. Preparatory to the transformation, they cease to take any food; and when the change is at hand, many of them may be observed alternately extending and contracting their bodies, as if disengaging themselves from the caterpillar skin. In their chrysalid state they remain for some time apparently inanimate, though actually in possession of life; and as soon as they have acquired strength sufficient to break the bonds that surround them, they exert their power, and appear in their perfect state. For a little time they continue humid and weak; but as the humidity evaporates, their wings and shell become hardened, and they soon afterwards commit themselves with safety to their new element.—(*See Illustrations*, *Fig.* 33.)

"Were a naturalist to announce," say Messrs Kirby and Spence, "the discovery of an animal which, for the first five years of its life, existed in the form of a serpent; which then, penetrating into the earth and weaving a shroud of the finest texture, contracted itself within this covering into a body resembling more than anything else an Egyptian mummy; and which, lastly, after re-

maining in this state without food and motion for three years longer, should burst its silken cerements, and start into day a winged bird, what a sensation would be excited by such strange intelligence: The metamorphoses of the insect world are equally strange and surprising. That butterfly, which amuses you with its aërial excursions, one while extracting nectar from the tube of the honeysuckle, and then, the very image of fickleness, flying to a rose, as if to contrast the hue of its wings with the colour of the flower, did not come into the world as you now behold it. At its first exclusion from the egg, and for some months afterwards, it was a worm-like caterpillar, crawling upon sixteen short legs, greedily devouring leaves with two jaws, and seeing by means of twelve eyes so minute as to be nearly imperceptible. You view it now furnished with wings capable of rapid and extensive flights; of its sixteen feet ten have disappeared, and the remaining six are wholly unlike those to which they have succeeded; its jaws have vanished, and are replaced by a curled-up proboscis suited only for sipping liquid sweets; the form of its head is entirely changed; two long horns project from its upper surface; and instead of twelve invisible eyes, you behold two, very large, and composed of at least 20,000 convex lenses, each supposed to be a distinct and effective eye. Dissect the animal, and compare its original internal conformation with its present, you will witness changes still more extraordinary. Nearly the whole body of the caterpillar was occupied by a capacious stomach; the butterfly has only an almost imperceptible thread-like viscus; the abdomen is now filled by two large packets of eggs: in the former, two spirally-convoluted tubes were filled with a silky gum; in the latter, both tubes and silk have almost totally vanished; and changes equally great have taken place in the economy and structure of the nerves and other organs. What a surprising transformation! Nor was this all. The change from one form to another was not direct: a state not less singular intervened. After casting its skin, even to its very jaws, several times,

and attaining its full growth, the caterpillar attached itself to a leaf by a silken girth. Its body greatly contracted, its skin once more split asunder, and disclosed an oviform mass, without exterior mouth, eyes, or limbs, and exhibiting no other symptom of life than a slight motion when touched. In this state of torpor the insect existed for many months, until at length the tomb burst; and out of a case not more than an inch long, and a quarter of an inch in diameter, proceeded the butterfly before you, which covers a surface of nearly four inches square."

The same authors have drawn a beautiful analogy between the different states of insects and those of the human soul. The butterfly, the representative of the soul, is prepared in the *larva* for its future state of glory; and if it be not destroyed by the ichneumons and other enemies to which it is exposed,—symbolical of the sins which destroy the spiritual life of the soul,—it will come to its state of repose in the *aurelia*, which is its Hades; and at length, when it assumes the *imago*, which is its heavenly existence, break forth with new power and beauty to its final glory.*

COMPOUND BODIES CONTINUED.—ALLOYS, SALTS.

Alloys.—METALS do not combine with one another in their solid state, owing to the influence of chemical affinity being counteracted by the force of cohesion. It is necessary to liquefy at least one of them, in which case

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* Linnæus has divided insects into seven orders, — Coleoptera, Hemiptera, Lepidoptera, Neuroptera, Hymenoptera, Diptera, and Aptera. The first two have their wings defended by a pair of hard crustaceous cases called *elytra;* the three subsequent orders have four membranaceous wings without elytra; the insects of the sixth order have but two wings, and under each of these, at its base, a poise or balancer, which seems to be of the same use to insects as a long pole, loaded at each end with lead, is to a rope-dancer; the seventh class includes all insects that are destitute of wings, as spiders, &c.

they always unite, provided their mutual attraction is energetic. Thus brass is formed when pieces of copper are put into melted zinc; and gold unites with mercury at common temperatures by mere contact. Metals appear to unite with one another in every proportion, precisely in the same manner as sulphuric acid and water. Thus there is no limit to the number of alloys of gold and copper.

Alloys are analogous to metals in their chief physical properties. They are opaque, possess the metallic lustre, and are good conductors of electricity and caloric; but they often differ materially in some respects from the elements of which they consist. The colour of an alloy is sometimes different from that of its constituents, of which brass is a remarkable example. The hardness of a metal is in general increased by being alloyed, and for this reason its elasticity and sonorousness are frequently improved. The malleability and ductility of metals, on the contrary, are usually impaired by combination. Their fusibility and their tendency to unite with oxygen are considerably augmented by being alloyed.

It is of importance to be acquainted with the principal alloys.—Equal parts of tin and lead constitute an alloy which is more fusible than either separately, and is the common solder of the plumbers and tinsmiths. Tin alloyed with small quantities of antimony, copper, and bismuth, forms the best kind of pewter. An alloy of three parts of lead to one of antimony constitutes the substance of which types for printing are made. Copper forms with tin several valuable alloys, which are characterized by their sonorousness. Bronze is an alloy of copper with about eight or ten per cent. of tin, together with small quantities of other metals which are not essential to the compound. Cannons are cast with an alloy of a similar kind. The best bell-metal is composed of 80 parts of zinc and 20 of tin; —the Indian gong, celebrated for the richness of its tones, contains copper and tin in this proportion. The *speculum-metal*, with which mirrors for telescopes are made,

consists of about two parts of copper and one of tin. The best brass consists of four parts of copper to one of zinc; and when the latter is in a greater proportion, compounds are generated which are called *Tombac*, *Dutch-gold*, and *Pinchbeck*. TURNER.

Salts.—BY the term *salt* chemists mean, in general, a definite compound of an acid, and an alkaline or salifiable base, both of which are in every case composed of at least two simple substances. Sulphate of potash, for instance, is a salt, the acid of which consists of oxygen and sulphur, and the base of oxygen and potassium. As every acid, with few exceptions, is capable of uniting with every alkaline base, and frequently in two or more proportions, it is manifest that the salts must constitute a very numerous class of bodies. Their properties are well deserving of attention. Nearly all salts are solid; their colour is very variable. Those that are soluble are more or less sapid, while those that are insoluble in water are insipid. Few of them are possessed of odour; the only one which is remarkable for this property being the carbonate of ammonia. Salts differ remarkably in their affinity for water. Thus, some salts, such as the nitrates of lime and magnesia, are *deliquescent*, that is, attract moisture from the air and become liquid. Others, which have a less powerful attraction for water, undergo no change when the air is dry, but become moist in a humid atmosphere; and others may be exposed without change to an atmosphere loaded with watery vapour. They differ likewise in the degree of solubility in water. Some dissolve in less than their weight of water; while others require several hundred times their weight of this liquid for solution, and others are quite insoluble. This difference depends on two circumstances,—the degree of their affinity for water, and their cohesion; their solubility being in direct ratio with the first, and in inverse ratio with the second. Salts which are soluble in water crystallize more or less regularly when their solutions are evaporated, and the form which they assume in crystallizing

constitutes an excellent character by which they may be distinguished from one another. Many of them, too, during the act of crystallizing, unite chemically with a definite portion of water, which forms an essential part of the crystal, and is termed the *water of crystallization*, and those which contain water of crystallization produce the greatest degree of cold during the act of dissolving in water; though most salts occasion a reduction of temperature during solution, especially if they are dissolved rapidly and in large quantity.

The best known and most useful of the salts is *muriate of soda*, or culinary salt; it abounds in the waters of the ocean, and chiefly occasions their peculiar taste. It is likewise found, in great abundance, in various parts of the globe, in a dry state. At Northwich, in England, is a salt mine, which yields 4000 tons of rock-salt a-year; and in Spain there is a remarkable solid mountain of salt, 500 feet high and a league in circuit; its depth below the surface of the earth being unknown. The shape of its crystals is a regular cube. Its taste is well known. It dissolves in 2½ parts of water, whether it be cold or boiling. It is not affected by exposure to the atmosphere. When heated, it breaks with a crackling noise, which phenomenon is termed *decrepitation*. By a greater heat it may be fused, and by a still greater volatilized; but heat cannot decompose it; for, after volatilization, it remains muriate of soda.

DETACHED SELECTIONS FROM VARIOUS POETS.

Upon thy mother's knee, a new-born child,
Weeping thou satst, whilst all around thee smiled;
So live, that, sinking into death's long sleep,
Calm thou mayst smile, while all around thee weep.

Sir W. Jones.—*From the Persian of Hafiz.*

And wherefore is the sweet spring tide
Worth all the changeful year beside!
The last-born babe—why lies its part
Deep in the mother's inmost heart?

But that the Lord and Source of love
Would have his weakest ever prove
Our tenderest care,—and, most of all,
Our frail immortal souls—His work and Satan's thrall!

KEBLE.

LIKE leviathans afloat
Lay their bulwarks on the brine;
While the sign of battle flew
On the lofty British line:
"Hearts of oak!" our captains cried; when each gun
From its adamantine lips
Spread a death-shade round the ships,
Like the hurricane-eclipse
Of the sun.
Again! again! again!
And the havoc did not slack,
Till a feeble cheer the Dane
To our cheering sent us back;—
Their shots along the deep slowly boom:—
Then ceased—and all is wail,
As they strike the shatter'd sail;
Or, in conflagration pale,
Light the gloom.—
Now joy, Old England, raise!
For the tidings of thy might,
By the festal cities' blaze,
While the wine-cup shines in light;
And yet, amidst that joy and uproar,
Let us think of them that sleep,
Full many a fathom deep,
By thy wild and stormy steep,
Elsinore! CAMPBELL.

THREE hosts combine to offer sacrifice;
Three tongues prefer strange orisons on high;
Three gaudy standards flout the pale-blue skies;
The shouts are France, Spain, Albion, Victory!
The foe, the victim, and the fond ally
That fights for all, but ever fights in vain,
Are met—as if at home they could not die—

To feed the crow on Talavera's plain,
And fertilize the field that each pretends to gain.

There shall they rot—Ambition's honour'd fools!
Yes, Honour decks the turf that wraps their clay!
Vain Sophistry! in these behold the tools,
The broken tools, that tyrants cast away
By myriads, when they dare to pave their way
With human hearts—to what?—a dream alone.
Can despots compass aught that hails their sway?
Or call, with truth, one span of earth their own,
Save that wherein at last they crumble bone by bone?

BYRON.

WHO should lament for him within whose heart
Love had no place, nor natural charity?
The parlour spaniel, when she heard his step,
Rose slowly from the hearth, and stole aside
With creeping pace: she never raised her eyes
To woo kind words from him, nor laid her head
Upraised upon his knee, with fondling whine.
How could it be but thus! Arithmetic
Was the sole science he was ever taught;
The multiplication-table was his creed,
His paternoster, and his decalogue.
When yet he was a boy, and should have breathed
The open air and sunshine of the fields,
To give his blood its natural spring and play,
He in a close and dusky counting-house
Smoke-dried, and sear'd, and shrivell'd up his heart.
So, from the way in which he was train'd up,
His feet departed not; he toil'd and moil'd,
Poor muckworm! through his threescore years and ten;
And when the earth shall now be shovell'd on him,
If that which served him for a soul were still
Within its husk, 'twould still be dirt to dirt.

SOUTHEY.

THOU art sounding on, thou mighty sea, for ever and the same!
The ancient rocks yet ring to thee, whose thunders nought can tame.

The Dorian flute that sigh'd of yore along thy wave, is still;
The harp of Judah peals no more on Zion's awful hill.
And Memnon's, too, hath lost the chord that breathed the mystic tone;
And the songs at Rome's high triumphs pour'd are with her eagles flown;
And mute the Moorish horn that rang o'er stream and mountain free,
And the hymn the learn'd Crusaders sang hath died in Galilee.
But thou art swelling on, thou deep, through many an olden clime,
Thy billowy anthem ne'er to sleep until the close of Time!

Mrs HEMANS.

THEN rose from sea to sky the wild farewell,—
Then shriek'd the timid, and stood still the brave,—
Then some leap'd overboard with dreadful yell,
As eager to anticipate their grave;
And the sea yawn'd around her like a hell,
And down she suck'd with her the whirling wave,
Like one who grapples with his enemy,
And strives to strangle him before he die.

And first one universal shriek there rush'd,
Louder than the loud ocean, like a crash
Of echoing thunder; and then all was hush'd,
Save the wild wind and the remorseless dash
Of billows; but at intervals there gush'd,
Accompanied with a convulsive splash,
A solitary shriek, the bubbling cry
Of some strong swimmer in his agony.

BYRON.

TRUE happiness has no localities;
No tones provincial, no peculiar garb.
Where duty goes, she goes; with justice goes;
And goes with meekness, charity, and love.
Where'er a tear is dried; a wounded heart
Bound up; a bruised spirit with the dew
Of sympathy anointed; or a pang
Of honest suffering soothed; or injury
Repeated oft, as oft by love forgiven;

Where'er an evil passion is subdued,
Or Virtue's feeble embers found; where'er
A sin is heartily abjured and left——
There is a high and holy place, a spot
Of sacred light, a most religious fane,
Where happiness descending, sits and smiles.

POLLOK.

MUTUAL DEPENDENCE OF THE FUNCTIONS OF ANIMALS.

THE communication of a new faculty renders necessary of course the provision of a new apparatus for the faculty; not only so, but it also requires a modification of the faculties already existing and common to both. This may be illustrated by tracing the manner by which it was necessary to modify the function of nutrition which is common to both vegetables and animals on the communication of the particular faculty of *voluntary motion.* The vegetable is fixed to one spot, and is therefore constantly in contact with its aliment, and needs no organs for containing it. But animals possess the property of locomotion, and cannot absorb their nourishment from the earth. They require, therefore, the means of transporting along with themselves the aliment necessary for their support. This necessity accounts for the internal cavity (the alimentary canal) with which the higher animals are furnished, and for the absorbent vessels which, attached to the walls of this cavity, convey the nutrient particles to the body. The cavity, with its contents, is to the animal what the soil is to the vegetable; its absorbing vessels constitute the internal roots of the animal. In consequence of nutrition ceasing to be the mere imbibition of sustenance from the soil or the atmosphere, preparatory operations become necessary to apprehend the food, to divide it, and to fit it for its common receptacle. These operations, you know, constitute digestion, which is thus a function of a secondary order, a modification of that peculiar function of nutrition which the faculty of locomotion renders indispensable. A second modification arises out of the necessity of conveying the nutrient matter to

different parts of the body. There must be a circulation of the nutritive fluid, consequently vessels must be provided to contain it; an engine must be constructed capable of propelling it into these various passages and cavities. Thus a circulation, with all the organs necessary to perform the function, is also connected with the faculty of voluntary motion. Nor does the matter stop here; a communication must be established between the digestive organs and the vessels which carry on the circulation. Thus the absorbents, which by one extremity are in communication with the intestines, and by the other with a main trunk of the circulating system, are also rendered indispensable. But the aliment, after it has undergone all the operations to which it is subjected in the digestive organs, is not fit for the purpose of nutrition, till, by another process, its heterogeneous particles are converted into one common nature. The function by which this is effected, you know, is respiration. A distinct organ for the function of respiration is thus another complication rendered necessary by a general circulation. In this manner you may perceive how the addition of one subordinate faculty, that of locomotion, creates the necessity for numerous subordinate expedients in order to complete it; that there is no such thing in the animal economy as an arbitrary disposition of parts, but that there is wisdom, beauty, and beneficence visible in every adjustment.

THE QUANTITY OF MATTER IN THE UNIVERSE.

THE earth is a globe about 8000 miles in diameter, and 25,000 in circumference; and, consequently, its surface contains nearly two hundred millions of square miles,—a magnitude too great for the mind to take in at *one* conception. In order to form a tolerable conception of the whole, we must endeavour to take a leisurely survey of its different parts. Were we to take our station on the top of a mountain of a moderate size, we should perceive an extent of view stretching 40 miles in every direction, forming a circle 80 miles in diameter, and 250 in circum-

ference, and comprehending an area of 5000 square miles. In such a situation, the scene around us, consisting of hills and plains, towns and villages, rivers and lakes, would form one of the largest objects which the eye, or even the imagination, can steadily grasp at one time. But such an object, grand and extensive as it is, forms no more than the *forty-thousandth part* of the terraqueous globe; so that, before we can acquire an adequate conception of the magnitude of the world, we must conceive 40,000 landscapes of a similar extent to pass in review before us; and, were a scene of equal magnitude to pass before us every hour, and were twelve hours a-day allotted for the observation, it would require 9 years and 48 days before the whole surface of the globe could be contemplated, even in this *general* and *rapid* manner.

These remarks apply to the earth as a mere superficies. But the earth is a solid globe; and its solid content is no less than 259,332,805,350 cubical miles,—a mass of material substance, in proportion to which all the lofty mountains which rise above its surface are less than a few grains of sand when compared with the largest artificial globe. Were the earth a hollow sphere, surrounded merely with an external shell, 10 miles thick, its internal cavity would be sufficient to contain a quantity of materials *one hundred and thirty-three times* greater than the whole mass of continents, islands, and oceans, on its surface, and the foundations on which they are supported. We have the strongest reasons, however, to conclude, that the earth, though not a solid mass from the surface to the centre, has, at least, a solid exterior crust of two or three hundred miles in thickness. What an enormous mass of materials, then, is comprehended within the limits of that globe on which we tread! How great must be the power of that Being who commanded it to spring from nothing into existence, who "measures the ocean in the hollow of his hand, who weigheth the mountains in scales, and hangeth the earth upon nothing!"

When we contemplate, by the light of science, those magnificent globes which float in the concave of the sky, the earth, with all its sublime scenery, stupendous as it is, dwindles into an inconsiderable ball. If we pass from our globe to some of the other bodies of the planetary system, we shall find, that one of these stupendous orbs is more than 900 times the size of our world, and encircled with a ring which would nearly reach from the earth to the moon; and that another is of such a size, that it would require 1500 globes of the bulk of the earth to form one equal to it in dimensions. The whole of the bodies which compose the solar system (without taking the sun and the comets into account) contain a mass of matter about 2500 times greater than that of the earth. The sun himself is 520 times larger than all the planetary globes taken together; and one million three hundred thousand times larger than the terraqueous globe.

If we extend our views from the solar system to the starry heavens, we have to penetrate, in our imagination, a space which the swiftest ball that was ever projected, though in perpetual motion, would not traverse in ten hundred thousand years. In those trackless regions of immensity we behold an assemblage of resplendent globes similar to the sun in size and in glory, and, doubtless, accompanied with a retinue of worlds, revolving, like our own, around their attractive influence. The immense distance, at which the nearest stars are known to be placed, proves that they are bodies of a prodigious size, not inferior to our own sun, and that they shine, not by reflected rays, but by their own native light. But bodies encircled with such refulgent splendour would be of little use in the economy of Jehovah's empire, unless surrounding worlds were cheered by their benign influence. Every star is therefore concluded to be a sun, no less spacious than ours, surrounded by a host of planetary globes, which revolve around it as a centre, and derive from it light, and heat, and comfort. Nearly a thousand of these luminaries may be seen in a clear winter night by the naked eye; so that a mass of matter equal to a thousand

solar systems, or to *thirteen hundred and twenty millions of globes of the size of the earth*, may be perceived, by every common observer, in the canopy of heaven. But all the celestial orbs which are perceived by the unassisted sight do not form the eighty-thousandth part of those which may be descried by the help of optical instruments. Dr Herschel has informed us that, when exploring the most crowded parts of the Milky-way, with his best glasses, he has had fields of view which contained no less than 588 stars, and these too continued for many minutes ; so that " in one quarter of an hour's time, there passed no less than *one hundred and sixteen thousand stars* through the field of view of his telescope." It has been computed, that nearly *one hundred millions* of stars might be perceived by the most perfect instruments, were all the regions of the sky thoroughly explored. And yet all this vast assemblage of suns and worlds, when compared with what lies beyond the utmost boundaries of human vision, in the immeasurable spaces of creation, may be no more than the smallest particle of vapour to the immense ocean.

Here, then, with reverence, let us pause and wonder! Over all this vast assemblage of material existence God presides. Amidst the diversified objects and intelligences it contains, he is eternally and essentially present. At his Almighty fiat it emerged from nothing into existence ; and by his unerring wisdom all its complicated movements are perpetually directed. Surely that man is little to be envied who is not impressed, by such contemplations, with a venerable and overwhelming sense of Creative Power.

DICK.

APPENDIX.

PREFIXES, AFFIXES, AND PRINCIPAL LATIN AND GREEK ROOTS OF THE ENGLISH LANGUAGE.*

(To be committed to Memory.)

I. PREFIXES.

1. OF ENGLISH OR SAXON ORIGIN.

A, *on* or *in*, as *a*-foot, *a*-bed.

Be, *about*, as *be*sprinkle; also *for* or *before*, as *be*speak.

En, *in* or *on*, as *en*circle; also *make*, as *en*feeble. (*En* is changed into *em* in roots beginning with *b* or *p*, as *em*bark, *em*power.)

Fore, *before*, as *fore*see.

Mis, *error* or *defect*, as *mis*deed.

Out, *excess* or *superiority*, as *out*run.

Over, *eminence* or *excess*, as *over*charge.

Un, before an adjective or adverb, signifies *not*, as *un*worthy, un,† before a verb, signifies the *undoing* of the act expressed by the verb, as *un*fetter.

Up, *motion upwards*, as *up*start; also *subversion*, as *up*set.

With, *from* or *against*, as *with*draw, *with*stand.

2. OF LATIN ORIGIN.

A, ab, abs, *from* or *away*, as *a*vert, *ab*solve, *abs*tain.

Ad, *to*, as *ad*here. (*Ad* assumes the various forms of *a*, *ac*, *af*, *ag*, *al*, *an*, *ap*, *ar*, *as*, *at*, according to the commencing letter of the root with which it is joined, as *a*scend, *ac*cede, *af*fix, *ag*grandize, *al*lot, *an*nex, *ap*peal, *ar*rest, *as*sume, *at*tract.)

Am, *round about*, as *am*bient.

Ante, *before*, as *ante*cedent.

Circum, *round* or *about*, as *circum*navigate. (*Circum* also takes the form *circu*, as *circu*it.)

Cis, *on this side*, as *cis*alpine.

Con, *together*, as *con*voke. (*Con* takes also the various forms of *co*, *cog*, *col*, *com*, *cor*, as *co*-operate, *cog*nate, *col*lect, *com*motion, *cor*relative.)

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* Those who are desirous to acquire further information on this important subject may consult the Author's *Manual of English Grammar*.

† *Un* is sometimes prefixed to a verb without altering the sense; as, *loose*, *unloose*.

Contra, *against*, as *contra*dict. (*Contra* sometimes takes the form *counter*, as *counter*balance.)
De, *down*, as *de*jected.
Dis, *asunder*, as *dis*tract, also *negation* or *undoing*, as *dis*arm. (*Dis* has also the forms of *di* and *dif*, as *di*verge, *dif*fuse.)
E, ex, *out of*, as *e*gress, *ex*clude. (*E*, *ex*, take also the form of *ec*, *ef*, as *ec*centric, *ef*flux.)
Extra, *beyond*, as *extra*ordinary.
In, before an adjective, signifies *not*, as *in*active; *in*, before a verb, signifies *in* or *into*, as *in*ject. (*In* has also the various forms of *ig*, *il*, *im*, *ir*, as *ig*noble, *il*luminate, *im*port, *ir*radiate.)
Inter, *between*, as *inter*vene.
Intro, *to*, *within*, as *intro*duce.
Juxta, *nigh to*, as *juxta*position.
Ob, *in the way of*, or *opposition*, as *ob*stacle. (*Ob* has also the various forms of *oc*, *of*, *o*, *op*, *os*, as *oc*cur, *of*fend, *o*mit, *op*pose, *os*tentation.
Per, *through* or *thoroughly*, as *per*forate, *per*fect. (*Per* has also the form of *pel*, as *pel*lucid.
Post, *after*, as *post*diluvian.
Pre or præ, *before*, as *pre*dict.
Preter or præter, *past* or *beyond*, as *preter*natural.
Pro, *for*, *forth*, or *forward*, as *pro*noun, *pro*voke, *pro*ceed.
Re, *back* or *again*, as *re*tract, *re*build.
Retro, *backwards*, as *retro*spect.
Se, *aside* or *apart*, as *se*cede.
Sine, *without*, as *sine*cure. (*Sine* has also the form of *sim* and *sin*, as *sim*ple, *sin*cere.)
Sub, *under* or *after*, as *sub*side. (*Sub* has also the forms of *suc*, *suf*, *sug*, *sup*, *sus*, contracted for *subs*, as *suc*ceed, *suf*fuse, *sug*gest, *sup*press, *sus*pend.)
Subter, *under* or *beneath*, as *subter*fuge.
Super, *above* or *over*, as *super*fluous. (*Super* has also the French form *sur*, as *sur*mount.)
Trans, *over from one place to another*, as *trans*port.
Ultra, *beyond*, as *ultra*mundane.

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3. OF GREEK ORIGIN.

A or an, *without* or *privation*, as *a*pathy, *an*onymous.
Amphi, *both* or *the two*, as *amphi*bious.
Ana, *through* or *up*, as *ana*tomy.
Anti, *against*, as *Anti*christ. (*Anti* has sometimes the contracted form of *ant*, as *ant*arctic.)
Apo, *from* or *away*, as *apo*stasy. (*Apo* has sometimes the contracted form of *ap*, as *ap*helion.)
Cata, *down*, as *cata*rrh. (*Cata* has also the form of *cat*, as *cat*echise.)
Dia, *through*, as *dia*phanous.
Epi, *upon*, as *epi*taph. (*Epi* has also the form of *ep*, as *ep*hemeral.)
Hyper, *over and above*, as *hyper*critical.
Hypo, *under*, as *hypo*thesis.
Meta, *change*, as *meta*morphosis. (*Meta* has also the form of *met*, as *met*hod.)
Para, *near to*, or *side by side as if for the purpose of comparison*, and hence sometimes *similarity*, and sometimes *contrariety*, *para*dox. (*Para* has also the form of *par*, as *par*ody.)
Peri, *round about*, as *peri*phrasis.
Syn, *together*, as *syn*thesis. (*Syn* has also the forms *sy*, *syl*, *sym*, as *sy*stem, *syl*logism, *sym*pathy.)

II. AFFIXES.

An	denoting the *agent* or *doer* of a thing,	as Comedi*an*
Ant		Assist*ant*
Ar		Li*ar*
Ard		Drunk*ard*
Ary		Advers*ary*
Eer		Chariot*eer*
Ent		Correspond*ent*
Er		Build*er*
Ist		Psalm*ist*
Ive		Representat*ive*
Or		Govern*or*
Ster		Game*ster*
Ate	denoting the *person acted upon*, and equivalent to the passive termination *ed*,	as Deleg*ate*
Ee		Trust*ee*
Ite		Favour*ite*
Acy	denoting *being* or *state of being* taken abstractly,	as Lun*acy*
Age		Parent*age*
Ance		Vigil*ance*
Ancy		Brilli*ancy*
Ence		Adher*ence*
Ency		Consist*ency*
Hood		Boy*hood*
Ion		Cohes*ion*
Ism		Hero*ism*
Ment		Abase*ment*
Mony		Acri*mony*
Ness		Bald*ness*
Ry		Rival*ry*
Ship		Lord*ship*
Th		Warm*th*
Tude		Servi*tude*
Ty or ity		Pover*ty*, brev*ity*
Ure		Legislat*ure*
Y		Master*y*
Dom	denoting *jurisdiction*,	as King*dom*
Ric		Bishop*ric*
Cle	diminutive terminations,	as Corpus*cle*
Kin		Lamb*kin*
Let		Stream*let*
Ling		Duck*ling*
Ock		Hill*ock*

Ac Al An Ar Ary En Ic *or* ical Ile Ine Ory	denoting *of* or *pertaining to*,	as Elegi*ac* Autumn*al* Sylv*an* Pol*ar* Parliament*ary* Gold*en* Angel*ic* or angel*ical* Infant*ile* Infant*ine* Olfact*ory*
Ate Ful Ose Ous Some Y	denoting *full of* or *abundance*,	as Affection*ate* Care*ful* Verb*ose* Zeal*ous* Toil*some* Flower*y*
Ish Like Ly	denoting *likeness*,	as Child*ish* God*like* Soldier*ly*
Ive	denoting *capacity in an active sense*,	as Persuas*ive*
Able Ible	denoting *capacity in a passive sense*,	as Laud*able* Elig*ible*
Less	denoting *privation*,	as Worth*less*
Ish	denoting *a smaller degree of*,	as Green*ish*
Ate En Fy Ish Ise Ize	denoting *to make*,	as Perpetu*ate* Hard*en* Puri*fy* Stabl*ish* Modern*ise* Civil*ize*
Escent	denoting *progression*,	as Conval*escent*
Ly	denoting *like* in quality,	as Tru*ly*
Ward	denoting *in the direction of*,	as Down*ward*

III. LATIN ROOTS WITH THEIR ENGLISH REPRESENTATIVES.

Root and Meaning.	Representative.	Example.
Acris, sharp	*acri*	*acri*mony
Acuo, I sharpen, acūtus, sharpened	*acu*, *acut*	*acu*men, *acute*
Aedes, a house	*edi*	*edi*fy, *edi*fice
Aequus, equal	*equ*, *equi*	*equ*animity, *equi*librium
Aër, air	*aeri*	*aeri*al, *aeri*form
Aether, the sky	*ether*	*ether*eal
Aevum, an age	*ev*	co*ev*al
Ager, agri, a field	*agri*	*agri*culture
Agger, a heap	*agger*	ex*agger*ate
Ago, I do, actus, done	*ag*, *act*	*ag*ent, *act*or
Ala, a wing	*ali*	*ali*ped
Alăcer, cheerful	*alacr*	*alacr*ity
Aliēnus, belonging to another	*alien*	*alien*, *alien*ate
Alo, I nourish	*ali*	*ali*ment
Alter, another	*alter*	*alter*ation
Altus, high	*alt*	ex*alt*, *alt*itude
Amīcus, a friend	*amic*, *imic*	*amic*able, in*imic*al
Amo, I love; Amor, love	*am*, *amor*	*am*iable, *amor*ous
Amplus, large	*ampli*	*ampli*fy
Ango, anxi, I vex	*ang*, *anx*	*ang*uish, *anx*iety
Angŭlus, a corner	*angul*, *angl*	*angul*ar, tri*angl*e
Anĭmus, mind	*anim*	*anim*ate, un*anim*ous, *anim*advert
Annus, a year	*ann*, *annu*, *enni*	*ann*als, *annu*al, bi*enni*al
Antīquus, ancient	*antiqu*	*antiqu*e
Aperio, I open, apertus, opened	*aperi*, *apert*	*aperi*ent, *apert*ure
Apto, I fit	*apt*	ad*apt*ation
Aqua, water	*aqua*, *aque*	*aqua*tic, *aque*duct
Arbĭter, a judge or umpire	*arbiter*, *arbitr*	*arbiter*, *arbitr*ary
Arbor, a tree	*arbor*, *arbour*	*arbor*aceous, *arbour*
Arceo, I drive away (erceo when compounded)	*erc*	co*erc*ion
Arma, arms	*arm*	*arm*y, *arm*istice
Aro, I plough	*ar*	*ar*able
Ars, artis, art	*art*, *ert*	*art*ful, in*ert*,
Artus, the joints	*arti*	*arti*culate
Asper, rough	*asper*	*asper*ity, ex*asper*ate
Audio, I hear, audītus, heard	*audi*, *audit*	*audi*ence, *audit*, *audit*ory
Augeo, I increase, auctus, increased	*aug*, *auct*, *auth*	*aug*ment, *auct*ion, *auth*or
Auspex, auspĭcis, a soothsayer	*auspic*	*auspic*ious
Avĭdus, greedy	*avid*	*avid*ity
Avis, a bird	*avi*	*avi*ary

Root and Meaning.	Representative.	Example.
Bacchus, the god of wine	*bacch*	*bacch*anal
Barba, a beard	*barb*	*barb*, *barb*er
Beātus, blessed	*beati*	*beati*tude
Bellum, war	*belli*, *bel*	*belli*gerent, re*bel*
Bellus, beautiful	*bell*	em*bell*ish
Bene, well	*bene*	*bene*diction
Bibo, I drink	*bib*	im*bib*e, wine-*bib*ber
Bini, two by two	*bin*	com*bin*ation
Bis, twice	*bi*	*bi*ped
Brevis, short	*brev*	*brev*ity, ab*brevi*ate
Cado, I fall, casus, fallen (changed into cĭdo when compounded)	*cad*, *casu*, *cid*	*cad*averous, *casu*al, ac*cid*ent
Cædo, I cut, cæsus, cut (changed into cīdo and cīsus when compounded)	*cid*, *cis*	homi*cid*e, in*cis*ion, pre*cis*e
Calor, heat	*calor*	*calor*ic
Calx, calcis, lime	*calc*	*calc*areous
Campus, a plain	*camp*, *champ*	en*camp*, *champ*aign
Cando, I set on fire, census, inflamed	*cand*, *cens*, *cend*	in*cand*escence, in*cens*e, in*cend*iary
Canis, a dog	*can*	*can*ine
Cano, canto, I sing	*cant*, *cent*	*cant*icles, pre*cent*or
Capillus, hair	*capill*	*capill*ary
Capio, I take, captus, taken (cipio and ceptus when compounded)	*cap*, *cip*, *cipi*, *capt*, *cept*	*cap*able, anti*cip*ate, re*cipi*ent, *capt*ure, re*cep*tion
Caput, capĭtis, the head	*capit*, *cipit*	*capit*al, pre*cipit*ate
Carcer, a prison	*carcer*	in*carcer*ate
Caro, carnis, flesh	*carn*	in*carn*ate, *carn*ivorous
Carus, dear	*car*	*car*ess
Cavus, hollow	*cav*	ex*cav*ate, con*cav*e
Cedo, I give place, I go, cessio, a giving place to	*ced*, *ceed*, *cess*	re*ced*e, suc*ceed*, con*ces*sion, ac*cess*
Celer, swift	*celer*	ac*celer*ate, *celer*ity
Centum, a hundred	*cent*	*cent*ury, *cent*ennial
Cera, wax	*cer*	*cer*ements
Cerno, I see, I sift, cretus, sifted	*cern*, *cret*, *creet*	dis*cern*, se*cret*ion, dis*creet*
Certus, certain	*certi*	*certi*fy
Cete, whales	*cet*	*cet*aceous
Charta, paper	*chart*	*chart*, *chart*er
Cinctus, girt about	*cinct*	suc*cinct*, pre*cinct*s
Cio, I call, I summon	*cit*	*cit*e, *cit*ation
Civis, a citizen	*civi*	*civi*l, *civi*lize
Clamo, I cry out	*clam*, *claim*	ex*clam*ation, pro*claim*
Clarus, clear	*clar*, *clari*	de*clar*e, *clari*fy
Claudo, I shut, clausus, shut (changed into cludo and clusus when compounded)	*clud*, *claus*, *clus*	ex*clud*e, *claus*e, se*clus*ion
Clemens, mild or merciful	*clemen*	*clemen*cy
Clino, I bend	*clin*	re*clin*e
Clivus, a slope	*cliv*	de*cliv*ity
Coelum, heaven	*cel*	*cel*estial
Colo, I cultivate, cultus, cultivated	*col*, *cult*	*col*ony, *cult*ure

Root and Meaning.	Representative.	Example.
Colossus, a statue of enormous size	*coloss*	*colossal*
Comes, comĭtis, a companion	*comit*	con*comit*ant
Commŏdus, convenient	*commod*	ac*commod*ate
Commūnis, common	*commun*	*commun*icate
Copia, plenty	*copi*	*copi*ous
Coquo, I boil, coctus, boiled	*cook*, *coct*	*cook*, de*coct*ion
Cor, cordis, the heart	*cord*	con*cord*, *cord*ial
Cornu, a horn	*corn*, *cornu*	uni*corn*, *cornu*copia
Corpus, corpŏris, the body	*corpus*, *corpor*, *corpu*	*corpus*cle, in*corpor*ate, *corpu*lent
Cras, to-morrow	*cras*	pro*cras*tinate
Credo, I trust	*cred*	*cred*it, *cred*ulous, *cred*ible
Cremo, I burn	*crem*	in*crem*ation
Crepo, I make a noise	*crep*	de*crep*itation
Cresco, I grow	*cresc*, *creas*	ex*cresc*ence, in*creas*e
Crimen criminis, a charge	*crimin*	*crimin*al
Crux, crucis, a cross	*cruci*	*cruci*fy
Cubo, I lie (cumbo when compounded)	*cub*, *cumb*	in*cub*ation, in*cumb*ent
Culīna, a kitchen	*culin*	*culin*ary
Culpa, a fault, culpo, I find fault with	*culp*	*culp*able, *culp*rit
Cumŭlus, a heap	*cumul*	ac*cumul*ate
Cura, care	*cura*, *cur*	*cura*tor, sine*cur*e
Curro, I run	*cur*, *curr*	in*cur*, *curr*icle, suc*cour*,
Cursus, a running	*cour*, *curs*, *cours*	ex*curs*ion, inter*cours*e
Curtus, short	*curt*	*curt*ail
Curvus, crooked	*curv*	*curv*e
Cutis, the skin	*cuti*	*cuti*cle
Damno, I condemn	*damn*, *demn*	*damn*able, con*demn*
Datus, given (ditus when compounded)	*dit*	ad*dit*ion
Decor, decōris, grace, beauty	*decor*	*decor*ous, *decor*ation
Dens, dentis, a tooth	*dent*	*dent*ist, *dent*ifrice
Densus, thick	*dens*	*dens*ity, con*dens*e
Deus, a god	*Dei*	*Dei*ty, *dei*fy
Dexter, right-handed, clever	*dexter*	*dexter*ity, *dexter*ous
Dico, I say, dictus, said	*dict*	pre*dict*, *dict*ate
Dies, day	*di*	*di*al, *di*ary, meri*di*an
Dignus, worthy	*digni*	*digni*ty, *digni*tary
Dimidium, half (Fr. demi)	*demi*	*demi*-god
Diurnus, daily	*diurn*, *journ*	*diurn*al, *journ*al
Doceo, I teach, doctus, taught	*doc*, *doct*	*doc*ile, *doct*or
Doleo, I grieve	*dol*	con*dol*e
Dolor, grief	*dolor*	*dolor*ous
Domĭnus, a master	*domin*	*domin*eer, *domin*ican
Domus, a house	*dom*	*dom*estic, *dom*icile
Donum, a gift	*don*	*don*ation
Duco, I lead, ductus, led	*duc*, *duct*	in*duc*e, aque*duct*
Duo, two	*du*	*du*al, *du*el
Durus, hard	*dur*	*dur*able
Ebrius, drunken	*ebri*	*ebri*ety, in*ebri*ate

Root and Meaning.	Representative.	Example.
Edo, I eat	*ed*	*ed*ible
Ego, I	*ego*	*ego*tist
Emo, I buy, emptus, bought	*eem*, *empt*	red*eem*, ex*empt*ion
Emŭlus, a rival	*emul*	*emul*ation, *emul*ous
Erro, I wander	*err*	ab*err*ation
Exter, outward	*exter*	*exter*nal
Faber, a workman	*fabr*	*fabr*ic
Facies, the face	*faci*, *fici*	*faci*al, super*fici*al
Facĭlis, easy	*facil*, *facul*, *ficul*	*facil*itate, *facul*ty, dif*ficul*ty
Facio, I make, fio, I am made, factus, made (ficio and fectus when compounded)	*fact*, *fect*, *fit*, *fic*, *fy*	*fact*or, per*fect*, bene*fit*, sopori*fic*, puri*fy*
Fallo, I deceive	*fall*	in*fall*ible
Fames, hunger	*fam*	*fam*ine
Fanum, a temple	*fan*, *fan*	pro*fan*ation, pro*fane*
Fari, to speak, fatus, having spoken	*fa*, *fat*	inef*fa*ble, *fat*e
Felix, felĭcis, happy	*felic*	*felic*ity
Femĭna, a woman	*femin*	*femin*ine, ef*femin*acy
Fero, I carry	*fer*	*fer*ry, in*fer*, circum*fer*ence
Fervio, I boil	*ferv*	*ferv*id, ef*ferv*escence
Fidēlis, faithful	*fidel*	*fidel*ity
Fido, I trust	*fid*	con*fid*e, dif*fid*ence
Filia, a daughter Filius, a son	*fili*	*fili*al, af*fili*ate
Filum, a thread	*fil*	*fil*ament
Fingo, I feign, fictus, feigned	*fig*, *fict*	*fig*ment, *fict*ion, *fict*itious
Finis, an end	*fin*	*fin*al, *fin*ite, de*fin*ite, de*fin*itive
Firmus, strong	*firm*	con*firm*
Fiscus, the imperial treasury	*fisc*	*fisc*al, con*fisc*ate
Fissus, cleft	*fiss*	*fiss*ure
Flagro, I burn	*flagr*	*flagr*ant, con*flagr*ation
Flatus, a puff of wind	*flat*, *flatu*	in*flat*ion, *flatu*lent
Flecto, I bend, flexus, bent	*flect*, *flex*	re*flect*, *flex*ible
Fligo, I dash, flictus, dashed	*flict*	con*flict*
Flos, floris, a flower	*flor*	*flor*ist, *flor*al
Fluctus, a wave	*fluctu*	*fluctu*ate
Fluo, I flow, fluxus, a flowing	*flu*, *flux*	*flu*ent, re*flux*
Foedus, foedĕris, a treaty	*feder*	con*feder*ate
Folium, a leaf	*foli*, *foil*	*foli*ate, tre*foil*
Foro, I bore	*for*	per*for*ate
Fors, fortis, chance	*fort*	*fort*uitous
Fortis, strong	*forti*	*forti*fy
Fossa, a ditch	*foss*	*foss*e
Fossus, dug	*foss*	*foss*il
Frango, I break, fractus, broken (fringo when compounded)	*frag*, *fract*, *fring*	*frag*ment, *fract*ure, in*fring*e
Frater, a brother	*frater*, *fratri*	*frater*nal, *fratri*cide

Root and Meaning.	Representative.	Example.
Frigeo, I am cold	*frig*	*frig*id, re*frig*eration
Frons, frontis, the forehead	*frontis*, *front*	*frontis*piece, af*front*
Fructus, fruit	*fructi*	*fructi*fy
Fruor, I enjoy	*fru*	*fru*ition
Frustra, in vain	*frustr*	*frustr*ate
Fugio, I flee, fugĭtus, fled	*fug*, *fugit*	re*fuge*, *fugit*ive
Fulgeo, I shine	*fulg*	re*fulg*ent
Fulmen, fulmĭnis, lightning	*fulmin*	*fulmin*ate
Fumus, smoke	*fum*	per*fume*, *fum*igate
Functus, having performed	*funct*	*funct*ion
Fundo, I pour out, fusus, poured out	*fund*, *fus*	re*fund*, *fus*ible, in*fuse*
Fundus, the bottom of anything	*fund*, *found*	*fund*amental, pro*found*
Gallus, a cock	*gall*	*gall*inaceous
Gelu, frost	*gel*, *geal*, *gelat*	con*gel*ation, con*geal*, *gelat*inous
Gens, gentis, a nation	*gent*	*gent*ile
Genu, a knee	*genu*	*genu*flexion
Genus, genĕris, kind or kindred, genĕra, kinds	*gener*, *genera*	de*gener*ate, *genera*
Germen, germĭnis, a bud	*germin*	*germin*ate
Gero, I carry, gestus, carried	*ger*, *gest*	belli*ger*ent, *gest*ure
Gigas, gigantis, a giant	*gigan*	*gigan*tic
Gigno, I beget, genĭtus, begotten	*gen*, *genit*	pro*gen*y, pro*genit*or
Glacies, ice	*glaci*	*glaci*al, *glaci*er
Glomus, glomĕris, a clew	*glomer*	ag*glomer*ation
Gluten, glutĭnis, glue	*glutin*	*glutin*ous
Gradior, I go, gradus, a steep, gressus, having gone	*grad*, *gred*, *gradu*, *gress*	retro*grade*, in*gred*ient, *gradu*ate, ag*gress*ion
Gramen, gramĭnis, grass	*gramini*	*gramini*vorous
Grandis, great	*grandi*	*grandi*loquent
Gratia, favour	*grat*, *grac*	*grat*uitous, in*grat*iate, *grac*e
Gratus, grateful, agreeable	*grat*	*grat*itude, in*grate*
Gravis, heavy	*grav*	*grav*ity
Grex, gregis, a flock	*greg*	*greg*arious, e*greg*ious
Gusto, I taste	*gust*	dis*gust*
Habeo, I have, habĭtus, had	*habit*, *hibit*	*habit*, in*habit*, ex*hibit*
Haereo, I stick, haesus, stuck	*her*, *hes*	ad*here*, co*hes*ion
Haeres, haerēdis, an heir	*hered*, *herit*	*hered*itary, in*herit*
Halo, I breathe	*hal*	ex*hale*, ex*hal*ation
Haurio, I draw, haustus, drawn	*haust*	ex*haust*
Herba, an herb	*herb*	*herb*al, *herb*ivorous
Hilăris, cheerful	*hilar*	ex*hilar*ate, *hilar*ity
Histrio, a player	*histrion*	*histrion*ic
Homo, a man	*homi*, *hum*	*homi*cide, *hum*an
Hora, an hour	*hor*, *horo*	*hor*al, *horo*loge
Hortor, I exhort	*hort*	ex*hort*
Hospes, hospĭtis, a guest	*hospit*	*hospit*able
Hostis, an enemy	*host*	*host*ile
Humĭdus, moist	*humid*	*humid*, *humid*ity

Root and Meaning.	Representative.	Example.
Humus, the ground	*hum*	in*hum*ation, post*hum*ous
Idem, the same	*iden*	*iden*tity
Ignis, fire	*ign*	*ign*ition, *ign*eous
Imāgo, imagĭnis, an image	*imag*, *imagin*	*imag*e, *imagin*ation
Imperium, power or government	*imper*	*imper*ial
Index, indĭcis, a discoverer	*indic*	*indic*ate
Infra, below	*infern*	*infern*al
Initium, a beginning	*initi*	*initi*ate
Insŭla, an island	*insula*, *insul*	pen*insula*, *insul*ate
Intĕger, entire	*integr*	*integr*ant
Intra, intus, within	*inter*, *inti*	*inter*nal, *inti*mate
Ira, anger	*ir*, *ira*, *irr*	*ir*e, *ira*scible, *irr*itable
Iter, itinĕris, a journey	*itiner*	*itiner*ate
Itĕrum, again	*iter*	*iter*ation
Itum, to go	*it*	ex*it*, circu*it*, trans*it*, sed*it*ion
Jaceo, I lie	*jac*	ad*jac*ent
Jactus, thrown (jectus when compounded)	*ject*	in*ject*, con*ject*ure
Janua, a gate	*jan*	*jan*itor
Jubĭlum, a shout of joy	*jubil*	*jubil*ee
Judex, judĭcis, a judge	*judic*	*judic*ial
Jugum, a yoke	*jug*	con*jug*ate
Junctus, joined	*junct*	ad*junct*, con*junct*ion
Juro, I swear	*jur*	con*jur*e
Jus, juris, right, law	*juris*, *juri*	*juris*diction, *juri*dical
Jutus, assisted	*jut*	ad*ju*tant, coad*jut*or
Juvĕnis, a youth	*juven*	*juven*ile
Lac, lactis, milk	*lact*	*lact*eal
Lacer, torn	*lacer*	*lacer*ate
Laedo, I hurt, laesus, hurt (lido and lisus when compounded)	*lid*, *lis*	col*lid*e, col*lis*ion
Lambo, I lick	*lamb*	*lamb*ent
Lamĭna, a thin plate	*lamina*	*lamina*ble
Lapis, lapĭdis, a stone	*lapid*	*lapid*ary, di*lapid*ate
Lapsus, having slid	*laps*	re*laps*e, col*laps*e
Latus, carried	*lat*	e*lat*ion
Latus, wide	*lat*	di*lat*e
Latus, latĕris, a side	*later*	*later*al
Laus, laudis, praise	*laud*	*laud*able, *laud*atory
Lavo, I wash, lotus, washed	*lav*, *lot*	*lav*e, *lot*ion
Laxus, loose	*lax*	re*lax*
Legātus, an ambassador	*legat*	de*legat*e
Lego, I bequeath	*leg*	*leg*acy
Lego, I gather, I choose, lectus, gathered	*leg*, *lect*	al*leg*e, col*lect*
Lenis, gentle	*len*	*len*ity
Lentus, gentle	*lent*	re*lent*
Lethum, letum, death	*leth*, *let*	*leth*al, *let*al
Levis, light	*lev*	*lev*ity
Levo, I lighten, I lift up	*lev*	e*lev*ate, *lev*er
Lex, legis, a law	*legis*, *leg*	*legis*lator, *leg*al
Liber, a book	*libr*	*libr*ary
Liber, free	*liber*	*liber*ty, *liber*al, *liber*tine
Libra, a balance	*libr*	*libr*ation, equi*libr*ium

Root and Meaning.	Representative.	Example.
Licet, it is lawful	*licit*	il*licit*
Lignum, wood	*lignum*, *lign*	*lignum*vitæ, *ligne*ous
Ligo, I bind	*lig*, *liga*	ob*lig*e, *liga*ment
Linea, a line	*linea*	*linea*ment
Linquo, I leave, lictus, left	*linqu*, *lict*	re*linqu*ish, re*lict*
Liqueo, I melt	*lique*	*lique*faction
Lis, litis, strife	*liti*	*liti*gious
Litĕra, a letter	*liter*	*liter*al, *liter*ature
Locus, a place	*loco*, *loc*	*loco*motion, *loc*ality
Longus, long	*long*	e*long*ate, *long*itude
Loqui, to speak	*loqui*, *loquy*, *loqu*, *locu*	col*loqui*al, ob*loquy*, *lo-quac*ity, ventri*loqu*ist, e*locu*tion
Lucrum, gain	*lucr*	*lucr*ative
Luctor, I struggle	*luct*	re*luct*ant
Ludo, I play, lusus, deceived	*ludi*, *lus*	*ludi*crous, il*lus*ion
Lumen, lumĭnis, light	*lumin*	*lumin*ary
Luna, the moon	*lun*	*lun*atic, sub*lun*ary
Luo, I wash	*lu*, *lut*, *luv*	ab*lu*ent, di*lut*e, al*luv*ial
Lustro, I purify	*lustr*	*lustr*e, *lustr*ation, il*lus-tr*ate
Lux, lucis, light	*luc*	*luc*id
Macies, leanness	*maci*	e*maci*ate
Macŭla, a spot	*macul*	im*macul*ate
Magnus, great	*magni*	*magni*fy
Major, greater	*major*	*major*ity
Malĕ, wickedly	*male*, *mal*	*male*volent, *mal*versation
Malleus, a hammer	*mall*, *malle*	*mall*et, *malle*able
Mamma, a breast	*mamma*, *mammi*	*mamma*lia, *mammi*ferous
Mando, I bid	*mand*	com*mand*, *mand*ate
Mando, I chew	*mand*	*mand*ible
Maneo, I stay	*man*, *main*	per*man*ent, re*main*
Mano, I flow	*man*	e*man*ate
Manus, a hand	*manu*, *mani*	*manu*al, *mani*pulation
Mare, the sea	*mar*	*mar*ine, *mar*itime
Mars, martis, the god of war	*mart*	*mart*ial
Mater, matris, a mother	*mater*, *matri*	*mater*nal, *matri*cide
Matūrus, ripe	*matur*	*matur*ity
Medius, middle	*medi*	*medi*ator, *medi*um
Mel, mellis, honey	*mell*	*mell*ifluous
Melior, better	*melior*	a*melior*ate
Memor, mindful	*memor*	*memor*able
Mens, mentis, the mind	*ment*	*ment*al
Mergo, I plunge, mersus, plunged	*merg*, *mers*	e*merg*e, im*mers*ion
Merĭtus, deserved	*merit*	*merit*orious
Merx, mercis, merchandise	*merc*	com*merc*ial
Metior, I measure, mensus, measured	*met*, *mensu*	*met*e, com*mensu*rate
Migro, I remove	*migr*	*migr*ate
Miles, milĭtis, a soldier	*milit*	*milit*ant
Mille, a thousand	*mill*	*mill*ennium
Minister, a servant	*minister*, *ministr*	ad*minister*, ad*ministr*ation
Minor, less	*minor*	*minor*, *minor*ity

Root and Meaning.	Representative.	Example.
Minuo, I lessen	*minu*, *min*	di*minu*tion, di*min*ish
Miror, I gaze	*mir*	*mir*ror, ad*mire*
Miser, wretched	*miser*	*miser*able
Mitis, mild	*miti*	*miti*gate
Mitto, I send, missus, sent	*mit*, *miss*	re*mit*, *miss*ionary
Modus, a measure	*mod*	*mod*e, *mod*ify
Mola, a millstone, flour	*mol*	e*mol*ument
Moles, a mass	*mol*	*mol*est, de*mol*ish
Mollis, soft	*molli*	e*molli*ent, *molli*fy
Moneo, I warn, monĭtus, warned	*mon*, *monit*	ad*mon*ish, *monit*or
Monstro, I point out	*monstr*	de*monstr*ate
Mors, mortis, death	*mort*	*mort*ify, im*mort*al
Mos, moris, a manner	*mor*	*mor*al
Moveo, I move, motus, moved	*mov*, *mot*	im*mov*able, re*mote*
Mucus, slimy matter	*muci*	*muci*laginous
Multus, many	*multi*	*multi*form
Munītus, fortified	*munit*	*munit*ion
Munus, munĕris, a gift	*muner*	re*muner*ate
Murus, a wall	*mur*	im*mure*
Muto, I change	*mut*	*mut*able
Nasus, the nose	*nas*	*nas*al
Natus, born	*nat*	*nat*ive, *nat*al
Nausea, loathing	*nause*	*nause*ous
Navis, a ship	*nav*	*nav*al, *nav*igate
Necto, I tie, nexus, tied	*nect*, *nex*	con*nect*, an*nex*
Nego, I deny	*neg*	*neg*ative
Nervus, a sinew	*nerv*	e*nerv*ate
Neuter, neither	*neuter*, *neutr*	*neuter*, *neutr*al
Niger, black	*negro*	*negro*
Nihil, nothing	*nihil*	an*nihil*ate
Noceo, I hurt, nocens, hurtful	*nocu*, *nocen*, *nox*	in*nocu*ous, in*nocen*t, *nox*ious
Nodus, a knot	*nod*	*nod*e
Nomen, nomĭnis, a name	*nomin*	de*nomin*ate
Non, not	*non*	*non*entity
Norma, a rule	*norm*	e*norm*ous
Nosco, I learn, notus, known	*nosc*, *not*, *niz*, *nit*	cog*nosc*ible, *not*ify, cog*niz*ance, recog*nit*ion
Novus, new	*nov*	in*nov*ate, *nov*ice
Nox, noctis, night	*nox*, *noct*	equi*nox*, *noct*urnal
Nubo, I marry, nuptus, married	*nub*, *nupt*	con*nub*ial, *nupt*ials
Nudus, naked	*nud*	de*nude*
Nugae, trifles	*nug*	*nug*atory
Nullus, none	*nul*, *nulli*	an*nul*, *nulli*fy
Numĕrus, a number	*numer*	*numer*ation
Nuncio, I tell	*nunci*, *nounc*	an*nunci*ation, re*nounce*
Nutrio, I nourish	*nutri*	*nutri*ment
Oblīquus, aslant	*obliqu*	*obliqu*ity
Oblivio, forgetfulness	*oblivi*	*oblivi*on
Occultus, hidden	*occult*	*occult*
Octo, eight	*oct*	*oct*agon
Ocŭlus, the eye	*ocul*	*ocul*ist
Odium, hatred	*odium*, *odi*	*odium*, *odi*ous
Odor, smell	*odor*	*odor*iferous

Root and Meaning.	Representative.	Example.
Officium, duty	*offic*	*offic*ial
Oleo, I smell	*ol*	*ol*factory, red*ol*ent
Omnis, all	*omni*	*omni*potent
Onus, onĕris, a burden	*oner*	*oner*ous, ex*oner*ate
Opăcus, dark	*opac*, *opaqu*	*opac*ity, *opaqu*e
Opto, I wish	*opt*	ad*opt*, *opt*ion
Opus, opĕris, a work	*oper*	*oper*ose, *oper*ation
Orbis, a circle	*orbi*	*orbi*cular
Ordo, ordĭnis, order	*ord*, *ordin*	*ord*ain, *ordin*ary, sub*or*-*din*ate
Oriens, orientis, rising, eastern	*orient*	*orient*al
Orno, I deck	*orn*	ad*orn*, *orn*ament
Oro, I beg	*ora*	inex*ora*ble, *ora*tor
Os, ossis, a bone	*oss*	*oss*ify
Os, oris, the mouth	*or*	*or*al, ad*or*ation, *or*ifice
Oscillum, a moving backwards and forwards	*oscill*	*oscill*ate
Otium, ease	*oti*	*oti*ose, neg*oti*ate
Ovum, an egg	*ov*	*ov*al, *ov*iform
Pactus, having bargained	*pact*	com*pact*
Pando, I spread, passus or pansus, spread	*pand*, *pass*, *pans*	ex*pand*, com*pass*, ex-*panse*
Par, equal	*par*	*par*ity
Pareo, I appear	*par*	ap*par*ent
Pario, I produce	*par*	*par*ent, vivi*par*ous
Paro, I prepare	*par*, *pair*	re*par*ation, re*pair*
Passer, a sparrow	*passer*	*passer*ine
Pastus, fed	*past*	*past*or
Pater, patris, a father	*pater*, *patri*, *parri*	*pater*nal, *patri*mony, *par*-*ri*cide
Patior, I suffer, passus, having suffered	*pati*, *pass*	*pati*ent, *pass*ive, *pass*ion
Patria, one's native country	*patri*	*patri*ot
Pauci, few	*pauci*	*pauci*ty
Pauper, poor	*pauper*	*pauper*ism
Pax, pacis, peace	*paci*	*paci*fic
Pecco, I sin	*pecc*	im*pecc*able
Pectus, pectŏris, the breast	*pector*	ex*pector*ate
Peculium, property	*pecul*	*pecul*ation
Pecunia, money	*pecuni*	*pecuni*ary
Pellis, a skin	*pelli*	*pelli*cle
Pello, I drive away, pulsus, driven	*pel*, *puls*	ex*pel*, re*puls*ion
Pendo, I hang, I weigh, pensus, hung, weighed	*pend*, *pens*	de*pend*, *pend*ulum, sti-*pend*, *pens*ive, com*pen*-sate
Pene, almost	*pen*	*pen*insula
Perdĭtus, lost	*perdit*	*perdit*ion
Perior, I try, perītus, skilled	*per*, *pert*	ex*per*iment, ex*pert*
Pes, pedis, the foot	*ped*	bi*ped*
Pestis, a plague	*pest*	*pest*iferous
Peto, I seek, petītus, sought	*pet*, *petit*	centr*pet*al, com*petit*ion
Pingo, I paint, pictus, painted	*paint*, *pict*	*paint*er, de*pict*
Pio, I worship, I appease, piātus, appeased	*pia*, *piat*	*pia*cular, ex*piat*e

Root and Meaning.	Representative.	Example.
Piscis, a fish, piscor, I fish	*pisca*	*piscatory*
Pius, pious	*pi*, *pie*	*pious*, *piety*
Placeo, I please	*plac*	*plac*id
Placo, I appease	*plac*	im*plac*able
Plaudo, I applaud	*plaud*, *plaus*	ap*plaud*, ap*plaus*e
Plebs, the common people	*pleb*	*pleb*eian
Plenus, full	*plen*	re*plen*ish, *plen*itude
Pleo, I fill, pletus, filled	*ply*, *plet*	sup*ply*, com*plet*e, ex*ple*tive
Plexus, twisted	*plex*	com*plex*
Plico, I fold	*plic*	com*plic*ate
Ploro, I wail	*plor*	de*plor*e
Plumbum, lead	*plumb*, *plum*	*plumb*er, *plum*met
Pœna, punishment	*pen*, *pun*	*pen*al, im*pun*ity
Pono, I place, posĭtus, placed	*pon*, *pos*, *posit*	de*pon*e, im*pos*e, *posit*ion
Popŭlus, the people	*popul*	*popul*ar
Porto, I carry, porta, a gate	*port*	ex*port*, *port*able, *port*al
Potens, potentis, powerful	*potent*	*potent*ate, pleni*potent*iary
Poto, I drink	*pot*	*pot*ion
Præda, plunder	*preda*	*preda*tory, de*preda*tion
Pravus, wicked	*prav*	de*prav*ity
Precor, I pray	*prec*	de*prec*ate
Prehendo, I take, prehensus, taken	*prehend*, *prehens*	ap*prehend*, com*prehen*sion
Pretium, a price	*preci*	ap*preci*ate
Primus, first	*prim*	*prim*ary, *prim*eval
Privo, I take away, privātus, taken away	*priv*, *privat*	de*priv*e, *privat*ion
Probo, I prove	*prob*	*prob*able
Probus, good	*prob*	*prob*ity
Proprius, one's own	*propri*	ap*propri*ate
Pudens, pudentis, bashful	*pudent*	im*pudent*
Puer, a boy	*puer*	*puer*ile
Pugna, a fight	*pugn*	*pugn*acious, im*pugn*
Pulvis, pulvĕris, dust	*pulver*	*pulver*ize
Punctum, a point	*punct*	*punct*uation
Pungo, I prick	*pung*	*pung*ent
Puto, I lop, I think	*put*	am*put*ate, re*put*ation, dis*put*e
Putris, rotten	*putr*	*putr*efaction
Quaero, I ask, quaesītus, sought	*quir*, *quest*, *quisit*, *quer*	in*quir*e, in*quest*, re*quisi*tion, *quer*y
Quassus (cussus when compounded) shaken	*cuss*	dis*cuss*
Quatuor, four	*quadr*	*quadr*angle
Queror, I complain	*quer*	*quer*ulous
Quinque, five	*quinqu*	*quinqu*ennial
Radius, a ray	*radius*, *radi*	*radius*, *radi*ate
Radix, radīcis, a root	*radic*	*radic*al, e*radic*ate
Ramus, a branch	*ram*	*ram*ification
Rapio, I seize, I carry off by force, raptus, seized	*rap*, *rapt*	*rap*ine, *rapt*ure
Rarus, thin	*rar*	*rar*ity, *rar*efy
Rasus, scraped	*ras*	*ras*or, e*ras*e
Ratio, rationis, reason	*ration*	*ration*al

Root and Meaning.	Representative.	Example.
Recens, recentis, new	*recent*	*recent*
Rectus, straight	*recti*	*recti*lineal
Rego, I rule, rectus, ruled	*reg*, *rect*	*reg*al, *rect*or
Res, a thing	*re*	*re*al
Rete, a net	*reti*	*reti*culate, *ret*ina
Rideo, I laugh at, risus, laughed at	*rid*, *ris*	de*rid*e, *ris*ible
Rigo, I water	*rig*	ir*rig*ate
Robur, robŏris, strength	*robor*	cor*robor*ate
Rodo, I gnaw, rosus, gnawed	*rod*, *ros*	cor*rod*e, cor*ros*ion
Rota, a wheel	*rota*	*rota*tion
Rotundus, round	*rotund*	*rotund*ity
Rumen, rumĭnis, the throat	*rumin*	*rumin*ate
Ruptus, broken	*rupt*	bank*rupt*, e*rupt*ion
Rus, ruris, the country	*rus*, *rur*	*rus*tic, *rur*al
Sacer, sacred	*sacri*, *secr*	*sacri*fice, con*secr*ate
Sagus, wise	*sag*	*sag*e
Sal, salt	*sal*	*sal*ine
Salio, I leap, saltus, leapt (silio and sultus when compounded)	*sali*, *sault*, *sil*, *sult*	*sali*ent, as*sault*, re*sil*e, in*sult*
Salvus, safe	*salv*	*salv*ation
Sanctus, holy	*sanct*	*sanct*ify
Sanguis, sanguĭnis, blood	*sanguin*	*sanguin*ary
Sanus, sound	*san*	*san*e, in*san*ity
Sapio, I taste (sipio when compounded)	*sap*, *sip*	*sap*id, in*sip*id
Satis, enough	*satis*, *sati*	*satis*fy, *sati*ate
Satur, full	*satur*	*satur*ate
Saxum, a rock	*saxi*	*saxi*frage
Scando, I climb (scendo when compounded)	*scend*	a*scend*
Scindo, I cleave, scissus, cleft	*scind*, *sciss*	re*scind*, re*sciss*ory
Scio, I know	*sci*	*sci*ence, pre*sci*ence
Scribo, I write, scriptus, written	*scrib*, *script*	in*scrib*e, *script*ure
Scrutor, I search diligently	*scrut*	*scrut*iny, in*scrut*able
Sculptus, carved	*sculpt*	*sculpt*ure
Scurra, a scoffer	*scurr*	*scurr*ility
Seco, I cut, sectus, cut	*seg*, *sect*	*seg*ment, dis*sect*
Sedeo, I sit, sessus, sat	*sed*, *sid*, *sess*	*sed*entary, as*sid*uous, *sess*ion
Semen, semĭnis, seed	*semin*	dis*semin*ate, *semin*ary
Semi, half	*semi*	*semi*circle
Senex, senis, old	*seni*	*seni*lity
Sentio, I feel, sensus, felt	*sent*, *sens*	*sent*ient, *sens*ation, dis*sen*
Sepelio, I bury, sepultus, buried	*sepul*, *sepult*	*sepul*chre, *sepult*ure
Sequor, I follow, secūtus, having followed	*sequ*, *secut*	sub*sequ*ent, per*secut*e, execute (ec-*secut*e)
Servo, I preserve	*serv*	ob*serv*e
Sidus, sidĕris, a star	*sider*	*sider*eal
Signum, a mark, signo, I mark	*sign*	de*sign*ate, *sign*ify
Silva, a wood	*silv*	*silv*an
Simĭlis, like	*simil*	*simil*ar, *simil*itude

Root and Meaning.	Representative.	Example.
Simul, at the same time	*simul*	*simul*taneous
Simŭlo, I feign	*simul*	dis*simul*ation
Sisto, I stop	*sist*	de*sist*
Socius, a companion	*soci*	*soci*al
Sol, the sun	*sol*	*sol*ar, *sol*stice
Solor, I comfort	*sol*	con*sol*e
Solus, alone	*sol*, *soli*	*sol*e, *sol*itude, *soli*loquy
Solvo, I loose, solūtus, loosed	*solv*, *solu*, *solut*	dis*solv*e, *solu*ble, *solut*ion
Somnus, sleep	*somni*	*somni*ferous
Sono, I sound	*son*	*son*orous
Sopor, sopōris, a deep sleep	*sopor*	*sopor*ific
Sorbeo, I suck in, sorptus, sucked in	*sorb*, *sorpt*	ab*sorb*ent, ab*sorpt*ion
Sors, sortis, a lot	*sort*	as*sort*
Sparsus, spread (spersus when compounded)	*spers*	di*sperse*
Spatium, space	*spati*, *spac*	ex*pati*ate, *spac*ious
Species, a form	*speci*	*speci*fic
Specio, I see, spectus, seen	*speci*, *spect*	*speci*ous, a*spect*
Specŭla, a watch-tower	*specul*	*specul*ate
Spero, I hope	*sper*, *spair*	de*sper*ate, de*spair*
Spiro, I breathe	*spir*	re*spir*ation, ex*pire* (ec-*spire*
Spolio, I plunder, spoliatus, plundered	*spoil*, *spoliat*	de*spoil*, *spoliat*ion
Spondeo, I promise, sponsus, promised	*spond*, *spons*	re*spond*, re*sponse*
Spontis, of one's own accord	*spont*	*spont*aneous
Stagnum, standing water	*stagn*	*stagn*ant, *stagn*ation
Statuo, I set up, I appoint, statūtus, appointed (stituo and stitūtus when compounded)	*statu*, *statut*, *stitu*, *stitut*	*statu*e, *statut*e, con*stitu*ent, sub*stitut*e
Stella, a star	*stell*	con*stell*ation
Sterĭlis, barren	*steril*	*steril*e, *steril*ity
Stillo, I drop	*stil*	di*stil*
Stimŭlus, a spur	*stimul*	*stimul*ate
Stinguo, I put out, stinctus, extinguished	*stingu*, *stinct*	ex*tingu*ish, ex*tinct*
Stipŭla, a straw	*stipul*	*stipul*ate
Stirps, the trunk of a tree, offspring	*stirp*	ex*tirp*ate (ec-*stirp*ate)
Sto, I stand, stans, standing, statum, to stand	*stat*, *stant*, *stic*	*stat*ure, di*stant*, sol*stic*e
Stringo, I bind, strictus, bound	*string*, *strict*	a*string*ent, re*strict*
Struo, I pile up, structus, piled up	*struct*, *strue*, *stroy*	*struct*ure, con*strue*, de*stroy*
Stultus, a fool	*stulti*	*stulti*fy
Suadeo, I advise, suasus, advised	*suad*, *suas*	dis*suad*e, per*suas*ive
Suavis, sweet	*suav*	*suav*ity
Summus, highest	*summ*	*summ*it, con*summ*ation
Sumo, I take, sumptus, taken	*sum*, *sumpt*	as*sum*e, con*sumpt*ion

Root and Meaning.	Representative.	Example.
Surgo, I rise, surrectus, risen	*surg*, *surrect*	in*surg*ent, re*surrect*ion
Tacĭtus, silent	*tacit*	*tacit*, *tacit*urn
Tango, I touch, tactus, touched	*tang*, *tig*, *tact*	*tang*ent, con*tig*uous, con*tact*
Tardus, slow	*tard*	re*tard*
Tego, I cover, tectus, covered	*teg*, *tect*	in*teg*ument, pro*tect*
Temno, I despise, temptus, despised	*temn*, *tempt*	con*temn*, con*tempt*ible
Tempus, tempŏris, time	*tempor*	*tempor*al, con*temporary*
Tendo, I stretch, tentus, stretched	*tend*, *tent*, *tens*	dis*tend*, ex*tent*, in*tense*
Teneo, I hold, tentus, held	*tain*, *tin*, *tent*	con*tain*, con*tin*ent, de*tent*ion
Tenuis, thin	*tenu*	*tenu*ity, at*tenu*ate
Tepeo, I am warm	*tep*, *tepe*	*tep*id, *tepe*faction
Terminus, a bound or limit	*termin*	*termin*ation, in*termin*able
Terra, the earth	*terr*, *ter*	*terr*aqueous, in*ter*
Testis, a witness	*test*	*test*ify, at*test*
Textus, woven	*text*	*text*ure, con*text*
Tollo, I lift up	*tol*	ex*tol*
Torreo, I roast	*torr*	*torr*id
Tortus, twisted	*tort*	ex*tort*
Totus, the whole	*tot*	*tot*al
Tracto, I handle	*tract*	*tract*able
Traho, I draw, tractus, drawn	*trah*, *tract*	sub*trah*end, ex*tract*
Tremo, I tremble	*trem*	*trem*endous, *trem*ulous
Tribūtus, given	*tribut*	dis*tribut*e
Tritus, rubbed	*trit*	*trit*uration
Trudo, I thrust, trusus, thrust	*trud*, *trus*	in*trud*e, ob*trus*ion
Tuber, a bump	*tuber*	pro*tuber*ance
Tubus, a pipe	*tub*	*tub*e
Tueor, I see, I protect, I look	*tuit*	*tuit*ion, in*tuit*ive
Turba, a crowd	*turb*	*turb*ulent, dis*turb*
Turgeo, I swell	*turg*	*turg*id
Turpis, base	*turp*	*turp*itude
Uber, fertile	*uber*	ex*uber*ant
Ultimus, last	*ultim*	*ultim*ate
Umbra, a shadow	*umbra*, *umbr*	*umbra*geous, *umbr*ella
Unda, a wave	*und*	in*und*ate, *und*ulate
Unguo, I anoint, unctus, anointed	*ungu*, *unct*	*ungu*ent, *unct*ion
Unus, one	*un*, *uni*	*un*animous, *uni*form
Urbs, a city	*urbs*, *urb*	sub*urbs*, *urb*an
Ustus, burnt	*ust*	comb*ust*ion
Utĭlis, useful	*util*	*util*ity
Uxor, a wife	*uxor*	*uxor*ious
Vacca, a cow	*vacc*	*vacc*ination
Vaco, I am empty	*vac*	*vac*ation, *vac*ancy
	vacu	e*vacu*ate, *vacu*um
Vado, I go	*vad*, *vas*, *wade*	in*vad*e, in*vas*ion, *wade*
Vagor, I wander	*vag*, *vagr*	*vag*abond, *vagr*ant
Valeo, I am strong	*val*, *vail*	pre*val*ent, pre*vail*

Root and Meaning.	Representative.	Example.
Vallus, a stake	*val*	inter*val*
Vas, any kind of vessel	*vas*	*vas*e
Vasto, I lay waste	*vast*, *waste*	de*vast*ation, *waste*
Veho, I carry	*vehi*, *vey*	*vehi*cle, con*vey*
Velox, velōcis, swift	*veloc*	*veloc*ity
Venio, I come, ventus, come	*ven*, *vent*	con*ven*e, ad*vent*
Ver, the spring	*ver*	*ver*nal
Vergo, I incline	*verg*	di*verg*e
Vermis, a worm	*vermi*	*vermi*cular
Verna, a home-born slave	*verna*	*verna*cular
Verto, I turn, versus, turned	*vert*, *vers*	re*vert*, di*vers*, *vers*atile
Verus, true	*ver*	a*ver*, *ver*ity
Vestis, a garment	*vest*	*vest*ment, in*vest*
Vetus, vetĕris, old	*veter*	*veter*an
Via, a way	*vi*	ob*vi*ate, ob*vi*ous
Vicinis, a neighbour	*vicin*	*vicin*ity
Video, I see, visus, seen	*vid*, *vis*	pro*vid*e, *vis*ible
Vigil, watchful	*vigil*	*vigil*ant
Vinco, I conquer, victus, conquered	*vinc*, *vict*	in*vinc*ible, *vict*ory
Vindex, vindĭcis, a defender	*vindic*	*vindic*ate
Viscus, viscĕris, a bowel	*viscer*	*viscer*al
Viscus, birdlime	*visc*	*visc*ous
Vita, life	*vit*	*vit*al
Vivo, I live	*viv*	*viv*id, sur*viv*e
Voco, I call, vocātus, called	*voc*, *vok*, *vocat*	irre*voc*able, re*vok*e, *voca*-*tive*
Volo, I will, I wish	*vol*	*vol*untary, bene*vol*ent
Volo, I fly	*vol*	*vol*atile
Volvo, I roll, volūtus, rolled	*volv*, *volut*	re*volv*e, re*volut*ion
Voro, I devour	*vor*	*vor*acious, carni*vor*ous
Vox, vocis, the voice	*voc*	*voc*al
Vulcānus, Vulcan the god of fire	*volcan*	*volcan*ic
Vulgus, the rabble	*vulg*	*vulg*ar, di*vulg*e
Vulsus, pulled	*vuls*	con*vuls*ion
Zona, a belt or girdle	*zon*	*zon*e

IV. GREEK ROOTS WITH THEIR ENGLISH REPRESENTATIVES.

Root and Meaning.	Representative.	Example.
Adelphos, a brother	*adelph*	phil*adelph*ia
Aethlos, a combat	*athlet*	*athlet*ic
Agōgos, a leader	*agogu*	dem*agogue*
Akouo, I hear	*acous*	*acous*tics
Aner, andros, a man	*andria*	di*andria*
Angello, I bring tidings	*angel*	ev*angel*ist
Anthos, a flower	*antho*	*antho*logy
Anthrōpos, a man	*anthrop*	phil*anthropy*
Arché, beginning, sovereignty	*arch*	hept*archy*, *arch*bishop
Arctos, a bear, the north	*arct*	*arct*ic
Aristos, best	*aristo*	*aristo*crat
Arithmos, number	*arithm*	*arithm*etic
Arōma, aromătis, odour	*aromat*	*aromat*ic
Artos, bread	*arto*	*arto*carpus
Asphaltos, bitumen	*asphalt*	*asphalt*ic
Asthma, breath	*asthma*	*asthma*tic
Astron, a star	*astro*	*astro*nomy
Atmos, vapour	*atmo*	*atmo*sphere
Autos, self	*auto*	*auto*graph
Bapto, I dip	*bapt*	*bapt*ism
Baros, weight	*baro*	*baro*meter
Biblion, a book	*biblio*	*biblio*graphy
Bios, life	*bio*	*bio*graphy
Bolbos, an onion	*bulb*	*bulb*ous
Bolé, a casting or throwing	*bolé*, *bola*, *ble*	hyper*bole*, para*bola*, par*able*
Chalyps, chaly̆bos, steel	*chalyb*	*chalyb*eate
Charis, charĭtos, grace, love	*char*, *charit*	eu*char*ist, *charity*
Cheir, the hand	*chir*	*chir*ography
Chilioi, a thousand	*chili*	*chili*ad
Cholé, bile	*cholé*	*chol*eric
Chroma, colour	*chroma*	a*chromat*ic
Chronos, time	*chrono*	*chrono*meter
Chrysos, gold	*chryso*	*chryso*lite
Dakty̆los, a finger	*dactyl*	*dactyl*
Deka, ten	*deca*	*deca*logue
Demos, the people	*dem*, *demo*	epi*dem*ic, *demo*cracy
Dendron, a tree	*dendr*, *dendron*	*dendr*itic, rhodo*dendron*
Despŏtes, a lord or master	*despot*	*despot*ic
Doxo, I will think, dedogmai, I have been judged, doxé, an opinion	*dox*, *dogma*	ortho*dox*, *dogma*tize
Dromos, a course	*drom*	hippo*drome*, *drom*edary
Drus, an oak	*dru*, *dry*	*dru*id, *dry*ad
Dynămis, power	*dynam*	*dynam*ics
Ecleipo, I fail	*eclip*	*eclip*tic, *eclip*se
Eidos, a form	*eido*	kal*eido*scope
Eiron, a dissembler	*iron*	*irony*

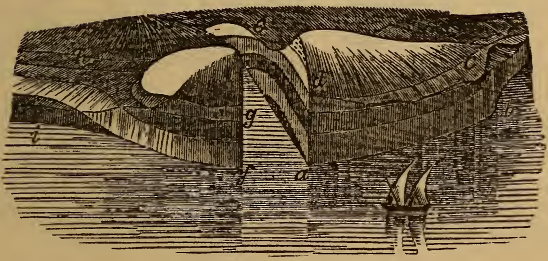
Root and Meaning.	Representative.	Example.
Epitŏmé, an abridgment	*epitom*	*epitom*ize
Epos, a word	*ep*	*ep*ic, ortho*epy*
Erēmos, a desert	*erem*	*erem*ite (hermit)
Ergon, work	*erg, urg*	en*erg*etic, metall*urgy*
Ethos, a custom	*eth*	*eth*ical
Eu, well	*eu, ev*	*eu*logy, *ev*angelist
Gala, galaktos, milk	*galax*	*galaxy*
Gamos, a marriage	*gam*	bi*gamy*
Gaster, the belly	*gastr*	*gastr*ic, *gastr*onomy
Gé, the earth	*geo*	*geo*graphy
Geno, I produce	*gen*	oxy*gen*, hydro*gen*
Genos, kind or race	*gen*	hetero*gen*eous
Glossa, glotta, the tongue	*gloss, glot*	*gloss*ary, poly*glot*
Glypho, I carve	*glyph*	hiero*glyph*ic
Gonia, a corner, an angle	*gon*	poly*gon*
Gramma, a letter, writing	*gram*	epi*gram*, *gram*mar
Grapho, I write, graphé, a writing	*graph*	auto*graph*, hydro*graphy*
Gynè, a woman	*gyn*	mono*gyn*ia, miso*gyn*ist
Gyros, a circle	*gyr*	*gyr*ation
Hagios, holy	*hagio*	*hagio*graphy
Hecăton, a hundred	*heca*	*heca*tomb
Helios, the sun	*helion*	ap*helion*
Hemĕra, a day	*hemer*	ep*hemer*al
Hemĭsus, half	*hemi*	*hemi*sphere
Hepta, seven	*hepta*	*hepta*gon
Hetĕros, dissimilar	*hetero*	*hetero*dox
Hex, six	*hexa*	*hexa*gon
Hiĕros, holy	*hier*	*hier*archy
Hippos, a horse	*hippo*	*hippo*potamus
Hodos, a way	*od*	ex*od*us
Homīlos, an assembly	*homil*	*homily*
Homos, similar	*homo*	*homo*logous
Hyălos, glass	*hyal*	*hyal*ine
Hydor, water	*hydro*	*hydro*statics
Hygros, wet	*hygro*	*hygro*meter
Ichthys, a fish	*ichthy*	*ichthy*ology
Isos, equal	*iso*	*iso*perimetrical
Kakos, bad	*caco*	*caco*phony
Kalos, handsome	*kal*	*kal*eidoscope
Kalypto, I cover, kalypso, I will cover	*calypt, calyps*	apo*calypt*ic, apo*calyps*e
Kalyx, a rosebud, a cup	*calyx*	*calyx*
Kardia, the heart	*cardi*	peri*cardi*um
Karpos, fruit	*carpus*	arto*carpus*
Kauso, I will burn	*caust, caut*	*caust*ic, *caut*erize
Kephălè, the head	*cephal*	hydro*cephal*us, *cephal*ic
Kosmos, the world, order	*cosm*	micro*cosm*, *cosm*etic
Kratos, strength	*crac, crat*	aristo*cracy*, aristo*crat*ic
Kyklos, a circle	*cycl*	epi*cycl*e
Kyon (cyon), a dog	*cyn*	*cyn*ic
Laos, the people	*lai*	*lai*ty
Lithos, a stone	*litho, lit*	*litho*graphy, chryso*lit*e
Logos, a word, description	*logo, logy, logu*	*logo*machy, chrono*logy*, cata*logu*e
Machè, a fight	*mach*	nau*machy*
Mania, madness	*mania*	*mania*c, biblio*mania*

Root and Meaning.	Representative.	Example.
Martyr, a witness	*martyr*	*martyr*ology
Mathētes, a scholar	*mathe*	*mathe*matics
Mechanão, I invent	*mechan*	*mechan*ic
Melan, black	*melan*	*melan*choly
Metron, a measure	*metr*, *meter*	geo*metry*, thermo*meter*
Micros, little	*micro*	*micro*scope
Misos, hatred	*mis*	*mis*anthrope
Monos, alone	*mono*	*mono*syllable
Morphè, shape	*morph*	meta*morph*osis
Mythos, a fable	*mytho*	*mytho*logy
Naus, a ship	*naut*	*naut*ical
Nekros, dead	*necro*	*necro*mancy
Neos, new	*neo*	*neo*logy
Nesos, an island	*nesus*	Pelopon*nesus*
Nomos, a law	*nom*	astro*nomy*
Nosos, sickness	*noso*	*noso*logy
Odè, a song or poem	*ode*, *od*, *ed*	ep*ode*, epis*ode*, mon*ody*, com*edy*
Oikeo, I dwell	*oeci*, *ochi*	ant*oeci*, peri*oeci*, par*ochi*al
Oikos, a house	*eco*	*eco*nomy
Olĭgos, little, few	*olig*	*olig*archy
Ophis, a serpent	*ophi*	*ophi*ology
Optŏmai, I see	*opti*	*opti*cal
Ornis, ornīthos, a bird	*ornitho*	*ornitho*logy
Orthos, right	*ortho*	*ortho*graphy
Oxys, acid	*oxy*	*oxy*gen
Pais, paidos, a boy	*ped*	*ped*agogue
Pathos, feeling	*path*	a*pathy*, anti*pathy*
Penté, five	*pent*	*pent*agon
Petra, a stone	*petra*, *petri*	*petra*logy, *petri*faction
Phagein, to eat	*phag*	anthropo*phagi*
Phaino, I show, I appear	*phan*, *phen*, *fan*	*phan*tom, *phen*omenon, *fan*tasy, *fancy*
Phemi, I speak	*phem*, *phas*, *phat*, *phet*, *phec*	blas*pheme*, em*phas*is, em*phat*ic, pro*phet*, pro*phecy*
Philos, a friend	*philo*, *phil*	*philo*sophy, *phil*anthropy
Phobeo, I terrify	*phob*	hydro*phob*ia
Phonè, the voice	*phon*	eu*phony*
Phren, the mind	*phren*	*phren*ology, *phrenzy*,
Phthongos, a sound	*phthong*	di*phthong*
Physis, nature	*phys*	*phys*ical
Polĕmos, war	*polem*	*polem*ical
Poleo, I sell	*pol*	biblio*pole*
Polis, a city	*polis*	metro*polis*
Polys, many	*poly*	*poly*gon
Potămos, a river	*potamus*	hippo*potamus*
Pous, podos, the foot	*pus*, *pod*	poly*pus*, anti*podes*
Presbutĕros, older	*presbyter*	*presbyter*ian
Pseudo, I deceive	*pseudo*	*pseudo*-apostle
Pteron, a wing	*ptera*	a*ptera*
Sarks, sarkos, flesh, the body	*sarco*	*sarco*phagus
Sbestos, extinguishable	*sbestos*	a*sbestos*
Sitos, corn, food	*sit*	para*site*
Skopeo, I see	*scop*	tele*scope*

Root and Meaning.	Representative.	Example.
Sophos, wise	*soph*	*soph*ist, philo*soph*
Stasis, a standing	*stas*, *stat*	ec*stasy*, ec*static*
Stello, I send	*stle*, *stal*	apo*stle*, peri*stal*tic
Strepho, I turn	*streph*	peri*streph*ic
Telè, distant	*telè*	*tele*scope
Technè, art	*techn*	*techn*ical
Thapto, I bury	*taph*	epi*taph*
Theoreo, I see	*theor*	*theory*
Theos, God	*the*, *thus*	a*the*ist, en*thus*iast
Thermos, warm	*thermo*	*thermo*meter
Tithēmi, I put, I suppose, thesis, a position	*thesis*, *thet*	hypo*thesis*, hypo*thet*ical
Topos, a place	*topo*	*topo*graphy
Zoon, an animal	*zoo*, *zo*	*zoo*logy, a*zo*te

ILLUSTRATIONS.

FIGURE 1 (page 4).



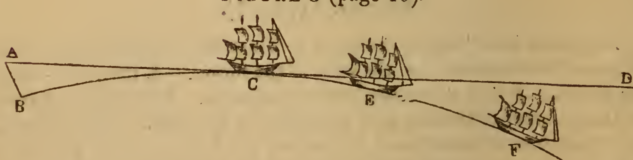
Portion of seacoast exhibiting the stratification of rocks.—*abcd*, and *fghi*, natural sections laid bare by the action of the weather, and showing various rocks superimposed in beds one above another.—*ade*, an artificial section, showing that stratification extends throughout the unseen parts of the earth's crust, as well as the visible parts.

FIGURE 2 (page 7).

The plant *heart's-ease*, designed to illustrate the organs of vegetation and fructification.—*a*, the stem of the flower.—*b*, the roots.—*c*, *c*, the leaves.—*d*, *d*, *d*, *d*, smaller leaves or *stipules*. The angle *e*, formed by the junction of the leaf with the stem, is the *axil*. The stalk *efg*, springing from the axil, and supporting the flower, is the *peduncle*. —*f*, *f*, scales or *bracts* near the upper end of the peduncle.—*g*, the *sepals* or external green leaves of the flower, which, taken collectively, form the *calyx*.—*h*, the *petals*, or yellow and purple leaves of the flower, of the same number as the sepals, but larger in size, which, taken collectively, form the *corolla*.—*i*, the *stamens*, five thin pale

yellow parts within the petals: They surround the *pistil* (*k*), a hollow body tapering into a zigzag cone, and terminating in a globular head.

FIGURE 3 (page 10).



Designed to illustrate the convexity of the earth's surface.—BCEF, the surface of the sea.—A, the position of a spectator on the coast, observing a vessel making out to sea.—AD, the horizon or line of vision, below which the eye of the spectator cannot reach.

FIGURE 4 (page 30).

This figure illustrates the leading steps in the process of blowing crown or window glass.

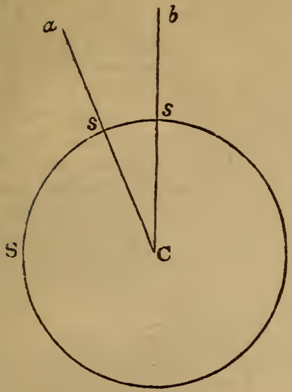
After the compost of which glass is made has been placed in a melting-pot, and reduced by heat to a liquid state, the workman takes an iron tube about six feet long, dips it into the pot of liquid glass, and gathers a sufficient quantity to form a sheet of glass. One man (*a*) then moulds the metal at the end of the tube into a regular form by rolling it on a smooth iron plate (*b*), while another (*c*) blows strongly through the tube, so as, by his breath, to expand it into the shape of a hollow pear (*d*). The blower next proceeds to heat it at the furnace, and again blow it; and between each blowing to press it against a bar (*e*), so as to form the bull's eye or centre part (*f*) of the sheet. When the glass has, by the dexterous management of this part of the operation, assumed a globular shape, it is rested on the casher-box (*g*), and an iron rod, called the punty-rod (*h*), on which a little hot metal has been previously gathered to make it adhere, is attached to the flat side exactly opposite the hollow tube (*i*), while the tube is detached from the globe of glass, leaving a circular hole in the glass of about two inches in diameter. Taking hold of the punty-rod, the blower again carries the glass to the furnace, and

presents the aperture made by the separation of the tube to the heat until it is sufficiently ductile. He then whirls it round, slowly at first, and afterwards with greater rapidity, still keeping it at the furnace, until, by the glass yielding to the centrifugal force, the aperture gradually enlarges, and at last suddenly flies open with a loud ruffling noise like the rapid unfurling of a flag in a strong wind, and leaves the glass a circular plane or sheet (k), about four and a half feet in diameter, of equal thickness throughout, except at the point called the bull's eye (f), where it is attached to the iron rod. The sheet of glass, now fully expanded, is moved round with moderate velocity, till it is sufficiently cool to retain its form. And, to make it ready for the glazier's use, it only farther requires to be tempered by being put for twenty-four hours in an annealing kiln.

FIGURE 5 (page 33).

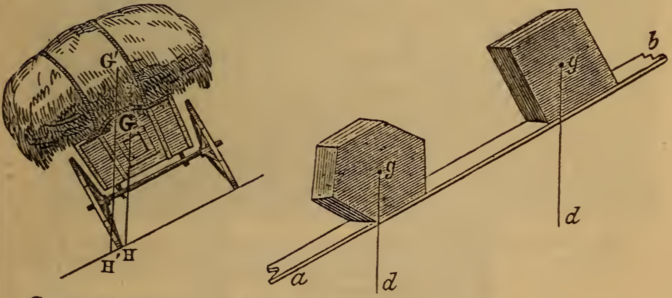
A limestone cavern.—*a*, *a*, masses of limestone suspended from the roof, or *stalactites*.—*b*, *b*, masses on the floor, or *stalagmites*.—*c*, *c*, pillars of alabaster already formed.—*d*, *d*, *e*, *e*, pillars in the course of formation.

FIGURE 6 (page 40).



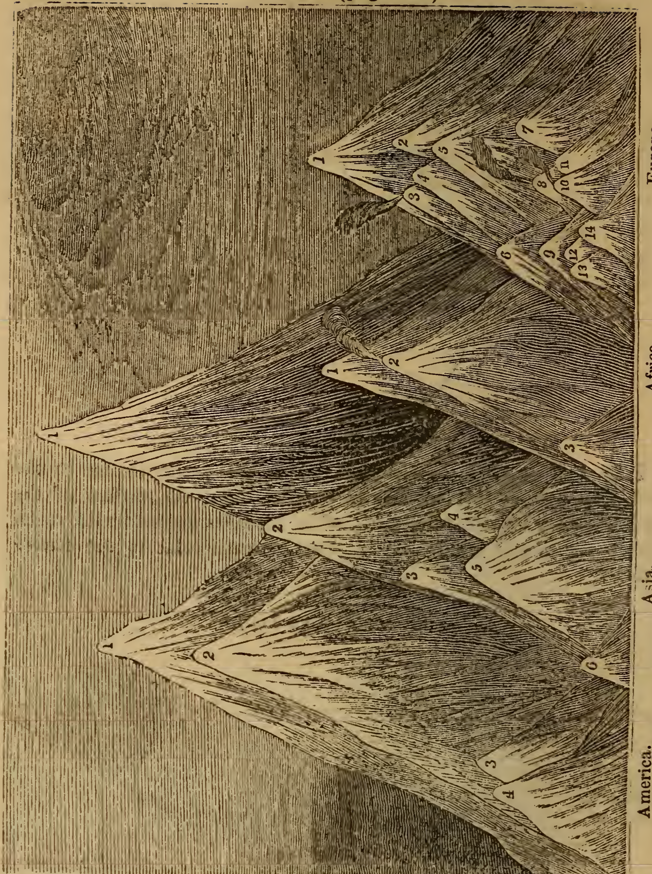
This diagram shows, that lines which are perpendicular to the earth's surface cannot be strictly parallel.—*sss*, the surface of the earth.—C, the centre of the earth, where all lines perpendicular to its surface necessarily meet.—*as*, *bs*, lines perpendicular to the earth's surface.

FIGURE 7 (page 112).



Centre of gravity.—G, G, *g*, *g*, the centres of gravity of the bodies.—GH, *gd*, *gd*, the lines of direction.—*ab*, H, inclined planes on which the bodies are placed. The cube will not roll down the plane, because the line of direction falls *within* its base; but the six-sided body will revolve, because the line of direction falls *beyond* its base. The cart will be overturned, if it is top-heavy; that is, if the centre of gravity is as high as G′; but it will move along the inclined plane without overturning, if the load is so disposed that the centre of gravity is kept as low as G.

FIGURE 8 (page 116).

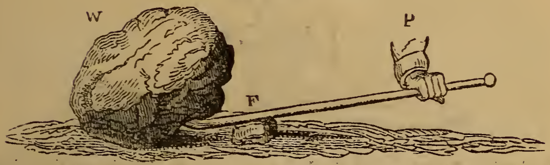


The relative heights of the principal mountains in the world, viz.

In Asia —	1. Highest peak of the Himalaya (Tibet),	28,177
	2. Ararat (Armenia), . .	17,230
	3. Peak of Lebanon (Palestine), .	12,000
	4. Olympus (Asia Minor), . .	9,000
	5. Sinai (Arabia), . . .	7,498
	6. Carmel (Palestine), . .	2,250
In America—	1. Aconcagua (Andes), . .	23,912
	2. Chimborazo (Andes), . .	21,440
	3. Highest peak of Blue Mountains (Jamaica), ...	7,278
	4. Mount Washington (Alleghanies),	6,630

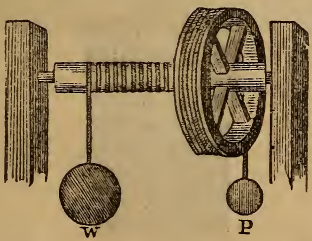
In Africa —	1.	Highest peak of Atlas,	15,000
	2.	Peak of Teneriffe,	12,236
	3.	Table Mountain (Cape Colony),	3,582
In Europe —	1.	Mount Blanc (Alps),	15,732
	2.	Simplon (Alps),	11,542
	3.	Etna (Sicily),	10,874
	4.	St Gothard (Alps),	10,595
	5.	Rusca (Carpathians),	9,912
	6.	Olympus (Turkey),	9,754
	7.	Parnassus (Greece),	8,068
	8.	Hecla (Iceland),	5,210
	9.	Ben Nevis (Scotland),	4,368
	10.	Vesuvius (Italy),	3,932
	11.	Snowdon (Wales),	3,521
	12.	Helvellyn (England),	3,055
	13.	Benlomond (Scotland),	3,175
	14.	Skiddaw (England),	3,038

FIGURE 9 (page 139).



The lever.—F, the fulcrum or prop on which the lever rests.—W, the weight to be raised.—P, the power or force applied to the lever.

FIGURE 10 (page 139).



The wheel and axle.—W, the weight to be raised, which is attached to a rope coiling round the axle.—P, the power or force applied to the outer rim of the wheel.

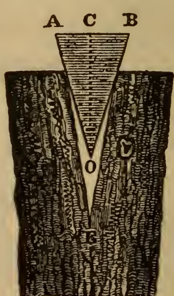
FIGURE 11 (page 140).

The single pulley.

FIGURE 12 (page 140).

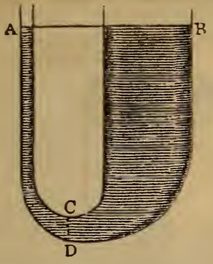
The inclined plane.—AC, the plane.—AB, height of the plane.

FIGURE 13 (page 140).



The wedge.—AOB, the wedge.—AB, back of the wedge.—AO, BO, the sides.

FIGURE 14 (page 141).



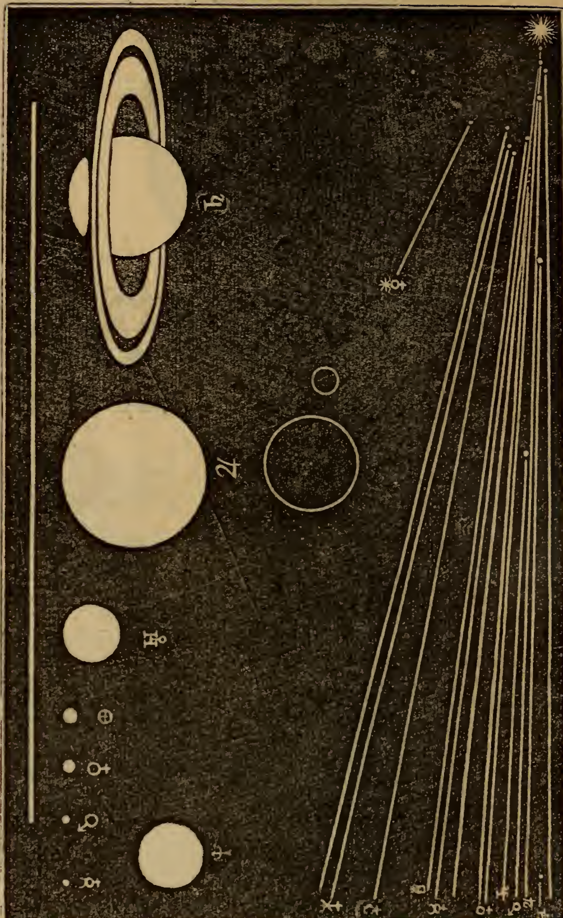
This figure illustrates the tendency of water to rise to its own level. The water stands at the level A, B, in both limbs of the bent tube ACDB, notwithstanding the difference of their width.

FIGURE 15 (page 156).

This figure illustrates the way in which springs are sometimes supplied from internal subterranean reservoirs of water, by the instance of an intermitting spring.

A, a cavity in the earth containing water, which varies in quantity according to the percolation of rain through small fissures in the rocks. —B, the outlet of the cavity.—BCD, the natural syphon through which the water flows to the mouth of the spring at D. When the water rises to the level line AC, the spring will begin to flow, and will continue flowing till the whole of the water is exhausted, because the level of the outlet (D) is below the level of the bottom of the reservoir.

FIGURE 16 (page 166).



The following 12 primary planets are distinguished by the annexed characters, viz. ☿ Mercury. ♀ Venus. ⊕ The Earth. ♂ Mars. ⚶ Vesta. ⚵ Juno. ⚳ Ceres. ⚴ Pallas. ♃ Jupiter. ♄ Saturn. ♅ The Georgium Sidus or Herschel. ♆ Neptune.

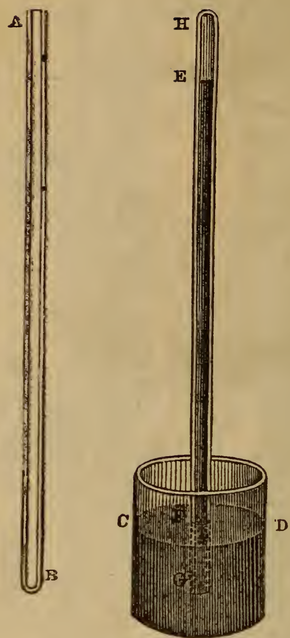
This illustration is introduced to give the pupil an idea of the relative magnitudes of some of the principal planetary bodies,—their mean distances from the sun,—and the inclination of their orbits.

The line in the margin, on the right hand side of the engraving, is the sun's semi-diameter. The eight figures adjoining, are eight of the principal planets according to their relative magnitudes. The two circles in the centre show the comparative size of the earth and moon. The lines on the left exhibit the inclination of the orbits of the planets, with their mean distances from the sun; the horizontal line being the earth's orbit or plane of the ecliptic.

FIGURE 17 (page 168).

Jerusalem and its environs, intended to familiarize the pupil with the principal places mentioned in the text.

FIGURE 18 (page 174).



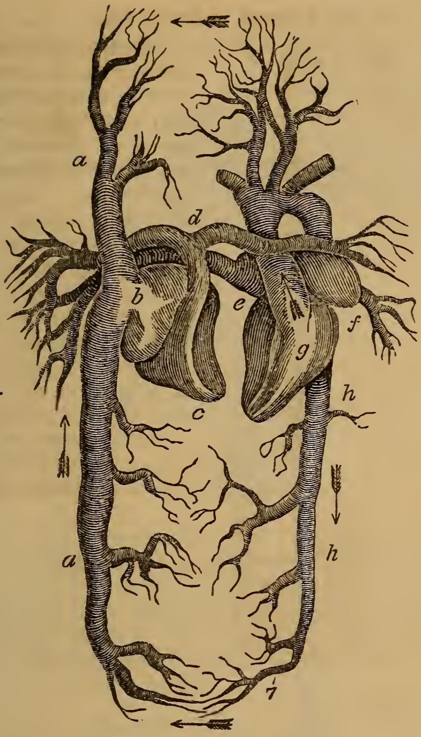
Principle and construction of the barometer.—AB, a glass tube, upwards of thirty-two inches in length, open at A and closed at B.—GH, the same tube filled with mercury, and inverted into a cup, CD, also filled with mercury. The mercury in the tube, instead of all running into the cup, will remain in the tube at the height of about twenty-nine inches above the surface CD, leaving the space HE, a vacuum, that is, emptied of air. The reason of this is, that the weight of the air which presses on the surface CD, supports or balances the column of mercury EF.

FIGURE 19 (page 196).

The Heart.—In this illustration, the heart, which in man and all the higher animals is double, or consists of two parts,—one for the circulation of the blood through the lungs,—the other for the circulation of the blood through the body, is for the sake of distinctness delineated, *first*, as if these parts were placed at some distance from each other; and, *second*, in their united form as they exist in nature.

a, *a*, represent the two great veins: the *superior*, which brings the blood from the head and upper extremities, and the *inferior*, which brings the blood from all the lower parts of the body. These two veins meet at *b*, and pour their blood into the *right auricle b*. The right auricle opens into the *right ventricle c*, which is larger and more muscular than the auricle. From the right ventricle, the blood flows into the *pulmonary artery d*, by which artery, and its various ramifications, it is carried all over the lungs, that it may be aërated or purified in that organ.

From the lungs it is returned by the pulmonary veins to the left heart, being received there by the *left auricle f*. The left auricle


a
d
b
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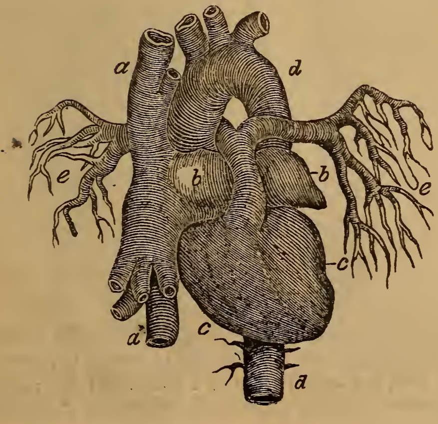
g
c
h
a
h
i


a
d
e
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b
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c
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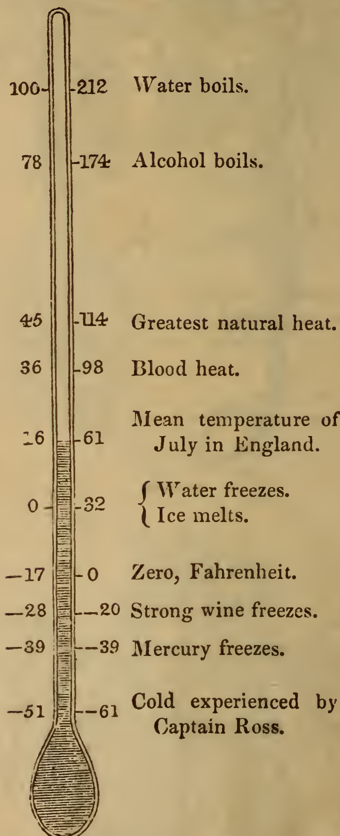
conveys it to the *left ventricle g*, which propels it into the *aorta* or great artery *h*; by which artery and its ramifications, it is conveyed to the extremities of the body, to be received by the veins, and again made to enter anew upon the same course of double circulation.

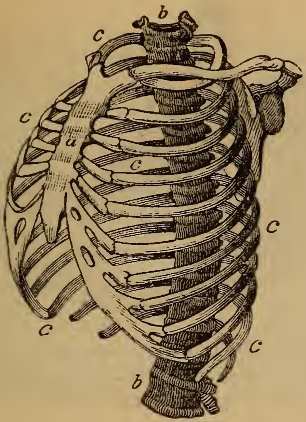
In the drawing of the united hearts, *a*, *a*, represents the superior and inferior veins.—*b*, *b*, the right and left auricles.—*c*, *c*, the right and left ventricles.—*d*, *d*, the aorta.—*e*, *e*, the pulmonary artery, with its branchings off into the right and left lungs.

FIGURE 20 (page 208).

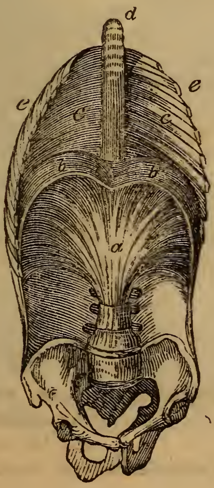


Thermometer, with the mercury standing at mean summer heat, and a scale of the chief points of temperature useful to be remembered. On the right side, the scale is that of Fahrenheit: the corresponding degrees, on the left side, are those of the centigrade thermometer.

FIGURE 21 (page 228).

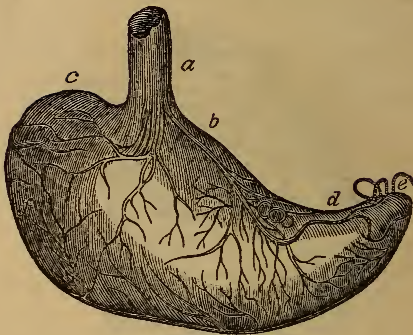


The first drawing under this head represents the *cavity of the thorax* or chest.—*a*, the *sternum* or breast-bone.—*b*, *b*, the *spine* or back-bone.—*c*, *c*, the *ribs*, of which there are twelve on each side. Within, this cavity is divided into three large compartments by a lining called the *pleura*. In the largest of these is contained the *right lung*, in the smallest the *heart*, and in the third the *left lung*.



The second drawing represents the *diaphragm* during the act of expiration, as seen from beneath, and shows its extension from the sternum to the loins, as also its convexity towards the chest, and its concavity towards the abdomen.—*a*, the centre of the diaphragm, which is of the nature of a tendon.—*b*, *b*, its circumference, which is fleshy.—*c*, *c*, the lateral cavities of the chest in which the lungs lie.—*d*, the lower end of the sternum or breast-bone.—*e*, *e*, the ribs.

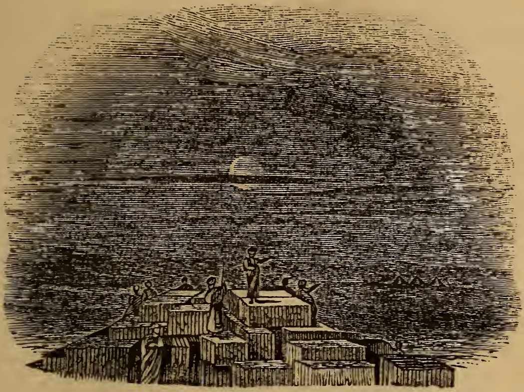
FIGURE 22 (page 229).



The first drawing under this head represents the *stomach* or organ of chymification.—*a*, the œsophagus.—*b*, the cardiac portion.—*c*, the great or left extremity.—*d*, the small or right extremity.—*e*, the stomach tied at the pylorus.

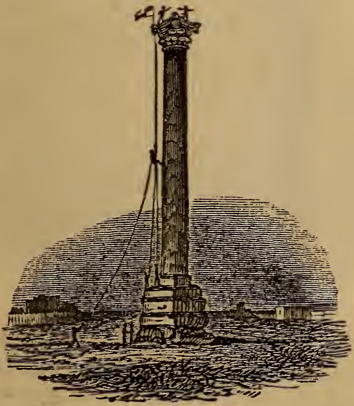
The second drawing represents the organs of chylification.—AA, the liver raised to show its upper surface.—B, the gall-bladder.—C,the stomach.—D, the situation of the pylorus.—DEH, the duodenum, or first of the small intestines.—F, the termination of the duct from the liver into the duodenum: By this duct, bile is poured from the liver into the duodenum.—G F, the pancreas duct, by which a fluid is poured from the pancreas into the duodenum. (The pancreas is not seen in the drawing, being situated in the back part of the abdomen, between the stomach and the spine).—H, K, the convolutions of the jejunum and ileum, or continuation of the intestines.

FIGURE 23 (page 236).



Top of the great pyramid at Djizeh.

FIGURE 24 (page 237).

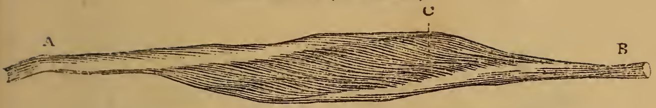


Pompey's Pillar.

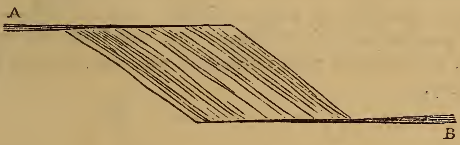
FIGURE 25 (page 238).

Exterior case of an Egyptian mummy. The case is made of wood, and contains the embalmed body within it. It is deposited in a tomb of the form of a chamber, and set upright (as in the figure), against the wall.

FIGURE 26 (page 273).

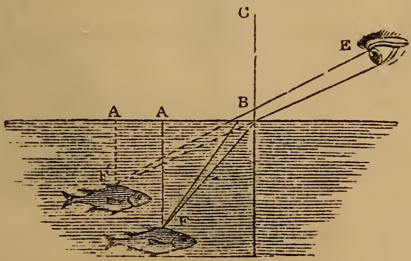


The first drawing represents a muscle.—A and B, the tendons.—A, the tendinous *origin*, is attached to a fixed point of bone.—B, the tendinous *insertion*, is attached to a part moveable by the contraction of the muscle.—C, the belly of the muscle, consists of fibres which are possessed of the power of contraction, and which thereby affect the various motions of the body.



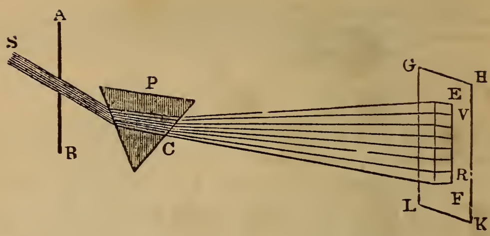
The second drawing, which is a section of the same muscle, shows the direction of these fibres.—A and B, the tendons, are on different sides of the muscle; and the fibres run obliquely between them, by which means quickness and variety of motion are greatly promoted,—points most important in all muscular action.

FIGURE 27 (page 279).



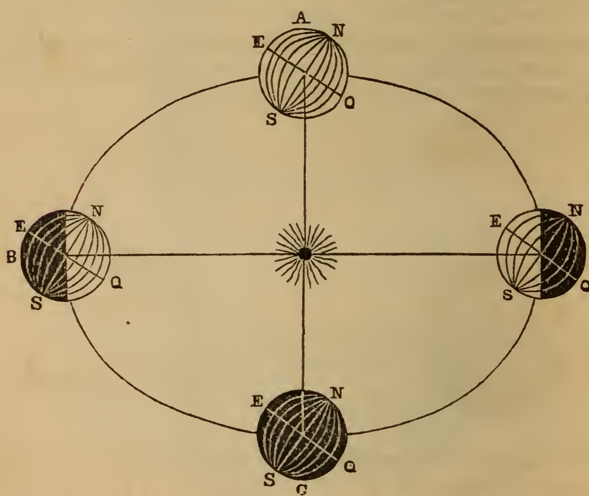
Refraction of light.—E, the eye of a spectator.—F, the position of a fish in the water.—FBE, the rays from the fish to the eye of the spectator bent by refraction at B, the surface of the water.—F′, the apparent position of the fish.—AF, its real depth in the water.—A′F′, its apparent depth.

FIGURE 28 (page 281).



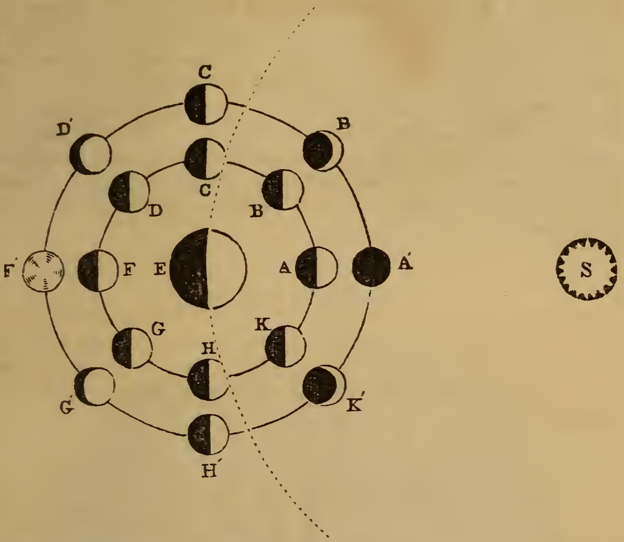
Decomposition of the solar ray.—P, a prism of glass.—S, the sun's ray passing through an aperture in the window AB.—CEF, the ray, after passing through the prism, separated into the seven coloured rays.—V, the violet, or most refrangible ray.—R, the red, or least refrangible ray.

FIGURE 29 (page 288).



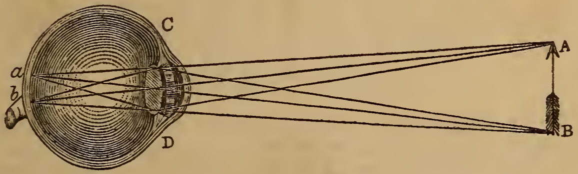
The seasons.—N, S, north and south poles.—E, Q, the equator.—A, position of the earth at the spring equinox.—B, position at midsummer.—C, position at the autumnal equinox.—D, position at midwinter.

FIGURE 30 (page 288).



Phases of the moon during its monthly revolution round the earth. —S, the sun.—E, the earth.—A, B, C, D, F, G, H, K, the moon at successive points (octants) of her revolution, from A, new moon, to K, her last octant.—A′, B′, C′, D′, F′, G′, H′, K′, the corresponding phases or appearances of the moon in these her successive octants, as seen from the earth.

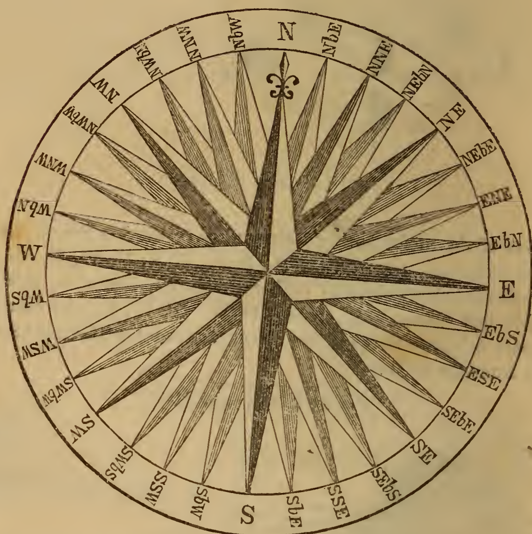
FIGURE 31 (page 295).



This figure is introduced to show the manner in which the images of objects are impressed upon the retina.—AB, is the object; and the lines represent the rays of light reflected from it into the eye.—A portion is intercepted by the iris. On the surface of the cornea, which is the transparent part of the eye, the rays are in a certain degree refracted. Passing through the coat called cornea, they enter the aqueous humour. In their transmission through it, they pass

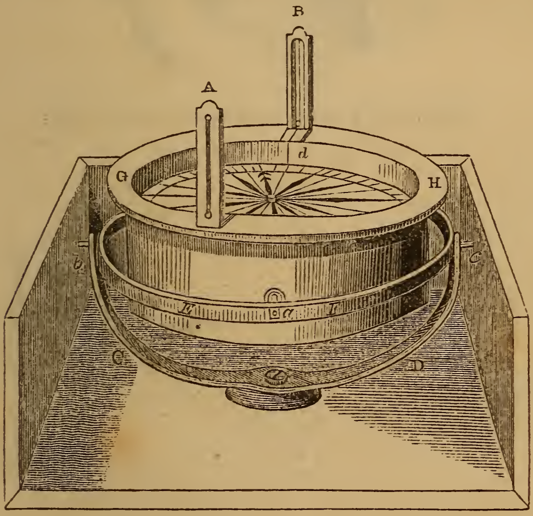
into the pupil. They enter the lens or crystalline humour, and by the greater power of refraction in this humour, the rays are drawn to a point, and impinge on the bottom of the eye at *a*, *b*. It will be further seen, that the rays coming from A are refracted to *b*, and those from B to *a*; so that the image of AB, formed upon the retina *ab*, is inverted. The inversion of the object, as represented on the retina, does not, however, affect our vision. Such is the power of habit and experience, that we see things as they are in reality, not as they are pointed in our eyes,—experience thus correcting the errors of sense. It is probably in the same way that we see single, though we have an image made in each eye.

FIGURE 32 (page 297).



The two figures under this head represent the Mariner's Compass. The first is the circular card, divided into thirty-two equal parts by lines drawn from the centre to the circumference, called *Rhumb Lines*; the intervals are subdivided into halves and quarters, called *Half-Points* and *Quarter-Points*; and the whole circumference into 360 degrees. The four principal points are called the *Cardinal Points*, two of which, opposite each other, are called the *North* and *South* points: that on the right hand, when we look towards the north, is termed the *East*, and its opposite the *West* point; the names of the half-points and quarter-points being compounded c these, according to their situation, and represented by the initial let

ters, as N. b. E. for north by east, &c. Under the card, along the north and south line, is fixed a small bar of steel, called the *Needle*, which being magnetized, or touched with a loadstone, acquires the peculiar property of pointing north and south, and consequently determines the direction of the other points of the horizon. The needle, having a small socket in the centre, is supported, along with the card, on the point of a fine steel pin, on which it turns freely, and the whole is enclosed in a circular brass box hung on hoops, to counteract the motion of the ship.



The second figure shows the compass mounted in the box, the nearest side of which is represented as wanting, in order to show the interior arrangement. The sights are placed vertically on the rim GH of the basin. The sight A, which the observer looks through, is a piece of brass with a narrow slit. The other sight B, is directed towards the object; down which slit passes a fine wire or horse-hair. There is a vertical line going down from B, which marks the degree on the rim of the card, when the card is stopped in an observation by a small lever connected with it. The compass-basin is supported by a semicircle of brass CD, passing below the basin, and screwed firmly to the bottom of the box; and it is suspended horizontally by two opposite pivots, one of which is seen at *a*, passing from its sides into a hoop of brass EF, which hoop, by means of pivots from two extreme points *b c*, is connected with and rests from the extremities of the semicircle CD.

FIGURE 33 (page 303).

Insects in the *larva*, *aurelia*, and *imago* states.

THE END.

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